To: Colecchia, Annamaria[Colecchia.Annamaria@epa.gov]; Chan, Suilin[Chan.Suilin@epa.gov]; Wieber, Kirk[Wieber.Kirk@epa.gov]; Sareen, Neha[sareen.neha@epa.gov]
From: Ruvo, Richard[/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=8BEBC83EDDF24444A73989F179BEE388-RUVO, RICHARD]
Sent: Tue 4/9/2019 6:41:59 PM (UTC)
Subject: RE: Letter to Facilities 1-hour exceedance

Good development. Thanks for raising the issue and working towards its solution.
Rick

From: Colecchia, Annamaria
Sent: Tuesday, April 09, 2019 1:56 PM
To: Chan, Suilin <Chan.Suilin@epa.gov>; Wieber, Kirk <Wieber.Kirk@epa.gov>; Sareen, Neha <sareen.neha@epa.gov>; Ruvo, Richard <Ruvo.Richard@epa.gov>
Subject: Fw: Letter to Facilities 1-hour exceedance

Looks like NJ is taking steps to resolve the modeled exceedances due to existing sources found in the Keasbey permit modeling. fyi.

From: Colecchia, Annamaria
Sent: Tuesday, April 9, 2019 1:53 PM
To: John, Greg
Cc: Dresser, Alan; Leon, Joel
Subject: Re: Letter to Facilities 1-hour exceedance

Greg,

That's very good. I would include a reasonable deadline for responding and resolving the issue. You may want to clarify the last sentence. It says that the facility has to resolve the NAAQS. The facility needs to resolve their significant contribution to the NAAQS violation. If they resolve the whole NAAQS, that's great but they only need to not have a significant impact. Also, which SIL are you looking for? Is it the NESCAUM 10ug/m3 or EPA's interim 7.5 ug/m3? I would suggest the 7.5 ug/m3 since it is more conservative and it is the value NJ sources have used for the cause or contribute phase of the analysis.

The main guidance for how to do this is the July 5, 1988 EPA policy memo that talks about the cause or contribute policy. This memo is also reaffirmed in the August 2010 policy memo and in the April 17, 2018 PM2.5 SIL guidance. Referenced below. The August 2010 is for SO2 but the same goes for NO2. In particular see pages on mitigation starting on P. 7 and the startups on P.11.

I may have an old letter that we used in Puerto Rico for a similar situation. I can scan it and send it tomorrow.

https://www.epa.gov/sites/production/files/2015-07/documents/appwso2.pdf

https://www.epa.gov/sites/production/files/2015-07/documents/reaffirm.pdf https://www.epa.gov/sites/production/files/2018-04/documents/sils_policy_guidance_document_final_signed_4-17-18.pdf

Guidance on Significant Impact Levels for Ozone and Fine Particles in the Prevention of Significant Deterioration Permitting Program - epa.gov

www.epa.gov

values for ozone and PM. 2.5, the EPA will consider whetherpermitting experience has confirmed that the recommended SIL values are suitable in all circumstances toshow that an increasein air quality concentration below the value does not cause or contribute to aviolation of the NAAQS

Guidance for Implementation of the 1-hour SO2 NAAQS Under PSD - United States Environmental Protection Agency | US EPA

www.epa.gov

guidance memorandum sets forth a recommended interim I-hour S02 significant impact level (SIL) that states may consider for carrying out the required PSD air quality analysis for S02,

---

From: John, Greg <Greg.John@dep.nj.gov>
Sent: Tuesday, April 9, 2019 12:40 PM
To: Colecchia, Annamaria
Cc: Dresser, Alan; Leon, Joel
Subject: Letter to Facilities 1-hour exceedance

Annamaria,

Do you have any recommendations or sample language for informing facilities of their contribution to a potential air quality exceedance?
Below is what I have quickly drafted.

“As recommended in the "Guideline on Air Quality Models" (40 CFR Part 51, Appendix W) and incorporated by reference in the regulations for the Prevention of Significant Deterioration of Air Quality, Title 40, Code of Federal Regulations (CFR) sections 51.166 and 52.21 in originally defined in June 1978 [Federal Register, 43 (118), 26 382-26 388], no concentration of a pollutant shall exceed: 1) The concentration permitted under the national secondary ambient air quality standard, or 2) the concentration permitted under the national primary ambient air quality standard, whichever concentration is lowest, for the pollutant period of exposure.

Air dispersion modeling performed in support of a recent Prevention of Significant Deterioration permit application has identified your facility as a significantly contributor to a modeled exceedance of the 1-hour average National Ambient Air Quality Standard (NAAQS) for nitrogen dioxide. Consequently, your facility must take measures to demonstrate compliance with this NAAQS.”

Thanks,

Greg John
Research Scientist
609-633-1106

Message

From:	John, Greg [DEP] [Greg.John@dep.nj.gov]
Sent:	9/22/2021 1:46:53 PM
To:	Sareen, Neha [sareen.neha@epa.gov]; Colecchia, Annamaria [Colecchia.Annamaria@epa.gov]
CC:	Zhang, Yiling [DEP] [Yiling.Zhang@dep.nj.gov]
Subject:	FW: Keasbey Energy Center Project (Facility ID 18940, Permit Activity BOP160004) - Multisource Air Quality Modeling Protocol (September 2021)
Attachments:	CPV_Keasbey_AQ Modeling Multisource Protocol_FINAL.pdf

FYI. I will have a hard copy and modeling files sent to you.

Greg

From: Ometz, Darin <DOmetz@trccompanies.com>
Sent: Monday, September 20, 2021 12:50 PM
To: John, Greg [DEP] <Greg.John@dep.nj.gov>
Cc: Zhang, Yiling [DEP] <Yiling.Zhang@dep.nj.gov>; Owen, David [DEP] <David.Owen@dep.nj.gov>; Andrew Urquhart <aurquhart@cpv.com>; Leon, Joel [DEP] <Joel.Leon@dep.nj.gov>; Khan, Aliya [DEP] <Aliya.Khan@dep.nj.gov>; Keller, Michael <MKeller@trccompanies.com>
Subject: [EXTERNAL] Keasbey Energy Center Project (Facility ID 18940, Permit Activity BOP160004) - Multisource Air Quality Modeling Protocol (September 2021)

Greg,

TRC is submitting the attached revised Multisource Air Quality Modeling Protocol (Revision 3) for the Keasbey Energy Center Project (Facility ID 18940, Permit Activity BOP160004) in response to the Department's October 29, 2020 notice of technical deficiency. In addition, and most recently on August 6, 2021 the NJDEP approved the single-source modeling analysis and requested that CPV Keasbey and TRC update the multisource modeling protocol.

As requested, the revised Multisource Air Quality Modeling protocol includes the necessary updates to the U.S. EPA dispersion model versions, updates to the meteorological and background monitoring concentration data, and updates to the facility emissions and design details that were provided in the Single Source Air Quality Modeling Analysis Report (May 2021) and approved on August 6, 2021. To facilitate the Department's review of the changes incorporated in the revised Multisource Air Quality Modeling Protocol (Revision 3 – September 2021) from the approved Multisource Air Quality Modeling Protocol (Revision 2 – May 2018), the cover letter provides descriptions of the proposed updates for your consideration.

If you have any questions concerning the attached Multisource Air Quality Modeling Protocol, please feel free to call me at (201) 508-6964. We look forward to receiving the Department's review comments/approval, as well as the opportunity to continue working with you on this project.

Regards,
Darin

Darin Ometz
Senior Air Quality Project Manager

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TRC

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September 20, 2021

Mr. Greg John
Division of Air Quality, Bureau of Evaluation and Planning
New Jersey Department of Environmental Protection
401 E. State Street, 2nd Floor
Trenton, New Jersey 08625

Re: Technical Deficiencies: Title V Significant Modification
Woodbridge Energy Center (Keasbey Energy Center Project)
Permit Activity Number: BOP160004 / Program Interest Number: 18940
Submittal of Revised Multisource Air Quality Modeling Protocol (Revision 3)

Dear Mr. John:

TRC Environmental Corporation (TRC) is submitting the enclosed revised Multisource Air Quality Modeling Protocol (Revision 3) for the Keasbey Energy Center Project (Facility ID 18940, Permit Activity BOP160004) in response to the Department's October 29, 2020 notice of technical deficiency. As you are aware and were a participant to, the NJDEP and CPV Keasbey had a virtual meeting on November 17, 2020 to discuss the Department's expectations with regards to updating the air dispersion modeling protocol, analysis, and report. In addition, and most recently on August 6, 2021 the NJDEP, in collaboration with U.S. EPA Region 2, approved the single-source modeling analysis and requested that CPV Keasbey and TRC update the multisource modeling protocol.

As requested, the revised Multisource Air Quality Modeling protocol includes the necessary updates to the U.S. EPA dispersion model versions, updates to the meteorological and background monitoring concentration data, and updates to the facility emissions and design details that were provided in the Single Source Air Quality Modeling Analysis Report (May 2021) and approved on August 6, 2021. To facilitate the Department's review of the changes incorporated in the revised Multisource Air Quality Modeling Protocol (Revision 3 – September 2021) from the approved Multisource Air Quality Modeling Protocol (Revision 2 –May 2018), the following sections have been updated. Brief descriptions of the proposed updates are also provided for your consideration.

<u>Updates to the revised Multisource Air Quality Modeling Protocol (Revision 3 – September 2021)</u>

- Section 1.0 – Removed references to multisource modeling requirements for SO_2 for consistency with the approved revised single source air quality modeling analysis (August 2021).
- Section 1.0 – Updated the pollutant specific significant impact areas as provided in Step 1 and Figures 1-10 to reflect the most recent single source modeling analysis (August 2021).
- Section 1.0 – Updated the pollutant specific maximum modeled concentrations as provided in Tables 3 and 4 to reflect the most recent single source modeling analysis (August 2021).

- Section 1.0 – Updated the initial multisource modeling inventory data for NO_2, PM-10, and PM-2.5 in Step 2 to incorporate the Department's initial NO_2 source inventory data included in the single-source modeling approval letter. (August 2021).

- Section 2.0 – Updated the initial modeling inventory to reference the NJDEP's updated list of eighty-five (85) major NO_2 facilities located in New Jersey to be evaluated for inclusion into the multisource modeling analysis. Note that any sources that were included in the initial source list from 2018 but were excluded from the source list in 2021 will be excluded from the multisource modeling analysis.

- Sections 2.1 and 2.2 – Revised Tables 7 and 8 and Figure 12 to incorporate the Department's initial NO_2 source inventory data that was included in the single-source modeling approval letter (August 2021).

- Section 2.3 – Revised Table 9 to incorporate the Department's initial NO_2 source inventory data that was included in the single-source modeling approval letter (August 2021). As discussed on November 17, 2020, the Department indicated that they would provide an updated multisource inventory for changes, if any, to the approved multisource inventory included in the final report Section 7 - Multisource Modeling (092718) submitted to the Department on September 27, 2018. The applicant understands based on the November 17, 2020 meeting that changes to the multisource inventory may be necessary because modeled offsite inventory sources may have changed the way they operate or may have made changes to their operating permits to demonstrate compliance with the NJDEP air quality regulations. As such, Table 9 provides the results of the AERSCREEN modeling analyses provided in the approved May 2018 Multisource Modeling Protocol for sources that did not undergo significant permit modifications for changes to permitted source operations or equipment. Table 9 provides the results of updated AERSCREEN modeling for sources that underwent significant permit modifications to change the way they operate significant sources and account for new or modified equipment. The revised AERSCREEN modeling files are provided in Appendix A. The facilities that have new or modified sources, emission rates, or stack exhaust parameters are provided in separate folders in the Appendix A DVD modeling files ("2021 Inventory_ Modified Facilities" and "2021_New Facilities in Inventory" folders).

- Section 2.4 – Revised Tables 10A and 10B to provide the most recent air quality monitoring data by season and hour of day per the approved single source modeling analysis (May 2021) and the methodology for calculating the background values as provided in the approved Multisource Modeling Protocol (May 2018).

- Section 2.4 – Revised Table 11 and Figures 13 and 14 to incorporate the Department's initial NO_2 source inventory data that was included in the single-source modeling approval letter (August 2021).

- Section 2.5 – Revised Table 12 and Figure 15 to incorporate the Department's initial NO_2 source inventory data that was included in the single-source modeling approval letter (August 2021). As discussed earlier, the applicant understands based on the November 17, 2020 meeting that changes to the multisource inventory may be necessary because modeled offsite inventory sources may have changed the way they operate or may have made changes to their operating permits to demonstrate compliance with the NJDEP air quality regulations. As such, Table 12 provides the results of the AERMOD modeling analyses to determine offsite source significant impact areas as provided in the approved Multisource Modeling Protocol (May 2018) for sources that did not undergo significant permit modifications for changes to source operations or equipment. Table 12 provides the results of updated AERMOD modeling for sources that underwent significant permit modifications to change the way they operate significant sources and account for new or modified equipment. The revised AERMOD modeling files are provided in Appendix A. The facilities that have new or modified sources, emission rates, or stack exhaust parameters are provided in separate folders in the Appendix A DVD modeling files ("2021_New and Modified Sources" folder).

- Section 2.6 – Updated the resulting inventory of Steps 1 through 4 for thirty-four (34) NO_2 major sources proposed for the 1-hour NO_2 cumulative NAAQS modeling as presented in Table 13. Figure 16 provides an updated map showing the locations of these sources relative to the ambient monitors and the KEC/WEC facility. The entire screening process worksheet is provided in Appendix A, along with the screening modeling files on a DVD.

- Section 3.0 – Updated background monitoring concentrations to provide the most recent air quality monitoring data per the approved single source modeling analysis (August 2021).

- Section 3.0 – Updated the pollutant specific significant impact areas and maximum concentrations as provided in Section 1.0 to reflect the most recent single source modeling analysis (August 2021).

- Section 3.0 – Updated Figure A-2 that illustrates the updated NO_2 modeling inventory sources and provides those receptors which exhibited single source concentrations equal to and greater than the NO_2 SIL, which will be assessed for the 1-hour NO_2 NAAQS.

- Section 4.0 – Updated Tables 16 and 17 to provide resulting inventory of Steps 1 through 4 for thirty-four (34) NO_2 major sources proposed for the 1-hour NO_2 cumulative NAAQS modeling.

- Section 4.1 – Updated the pollutant specific worst case operating scenarios for WEC/KEC and Tables 18-26 to reflect the most recent single source modeling analysis (August 2021).

- Section 5.0 – Updated the air quality model versions to reflect the most recent single source modeling analysis (August 2021).

- Section 5.0 – Updated the pollutant specific significant impact areas and maximum concentrations as provided in Section 1.0 to reflect the most recent single source modeling analysis (August 2021).

- Section 5.0 – Removed references to multisource modeling requirements for SO_2 for consistency with the approved single source air quality modeling analysis (August 2021).

If you have any questions concerning the attached Multisource Air Quality Modeling Protocol, please feel free to call me at (201) 508-6964. We look forward to receiving the Department's review comments/approval, as well as the opportunity to continue working with you on this project.

Sincerely,

TRC

Darin Ometz

Darin Ometz
Senior Air Quality Project Manager

CC: A. Urquhart, CPV (via email)
D. Owen, NJDEP (via email)
A. Khan, NJDEP (via email)
J. Leon, NJDEP (via email)
Y. Zhang, NJDEP (via email)
M. Keller, TRC (via email)

MULTISOURCE AIR QUALITY MODELING PROTOCOL

Prepared for the

CPV Keasbey, LLC
Keasbey Energy Center
Combined Cycle Power Facility
Township of Woodbridge, Middlesex County, New Jersey

Submitted to

New Jersey Department of Environmental Protection
Trenton, New Jersey

Prepared by

TRC
1099 Wall Street West, Suite 250B
Lyndhurst, New Jersey 07071

December 2017
Revision 1 - April 2018
Revision 2 - May 2018
Revision 3 – September 2021

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Appendix A: Modeling Screening Files for 1-Hour NO_2 Screening and Inventory Development

1.0 Introduction

TRC, on behalf of CPV Keasbey, LLC, submitted to the NJDEP and U.S. EPA a single source modeling analysis for the proposed Keasbey Energy Center (KEC) (the Project) (Applicant) in April 2017 with updates to the modeling analysis and Section 5 of the Technical Support Document provided to the Department on May 26, 2021. The proposed project is a nominal 630 megawatt (MW) 1-on-1 combined cycle power facility to be located in Woodbridge Township, Middlesex County, New Jersey. The Project is being permitted as a major modification to an existing major source, CPV Shore, LLC's nominal 725 MW 2-on-1 combined cycle power facility known as Woodbridge Energy Center (WEC). The NJDEP approved the single source air quality modeling analysis (September 2017) on November 20, 2017, and provided a list of sources to be considered for the major source modeling analysis for the modeling demonstration of compliance with the National Ambient Air Quality Standards (NAAQS) and PSD Increments. Subsequently, updates to the single modeling analysis and Section 5 of the Technical Support Document were provided to the Department on May 26, 2021 and were approved by NJDEP on August 6, 2021. With the single source modeling approval, the NJDEP provided an updated list of sources to be considered for the NAAQS compliance demonstration.

The permitted emission units at the two facilities are as follows.
Keasbey:

- Single combustion turbine with a supplemental fired heat recovery steam generator (natural gas fired only)
- Auxiliary boiler (natural gas fired only)
- Diesel fire pump (DFP) (ultra-low sulfur distillate fired only)
- Emergency diesel generator (EDG) (ultra-low sulfur distillate fired only)
- 10-cell cooling tower

Woodbridge:

- Two combustion turbines each with a supplemental fired heat recovery steam generator (natural gas fired only)
- Auxiliary boiler (natural gas fired only)
- Diesel fire pump (DFP) (ultra-low sulfur distillate fired only)
- Emergency diesel generator (EDG) (ultra-low sulfur distillate fired only)
- 14-cell cooling tower

The permitted operating scenarios for these facilities are identified in Table 1 and Table 2, respectively.

Table 1: Keasbey Energy Center Permitted Operating Scenarios

OS#	Emission Unit Description
	U200 Combined Cycle Unit 201 with GE 7HA.02 Turbine
OS1	E201 Firing NG - No duct burning
OS2	E201 Firing NG - with duct burning
OS4	E201 Firing NG – Rapid Response Start Up
OS5	E201 Firing NG – Rapid Response Shut Down
OS9	E201 - Shake Down
	E203 Auxiliary Boiler – 72.3 MMBtu/hr
OS1	Natural Gas Fired Auxiliary Boiler
	U204 Emergency Fire Pump -305 HP
OS1	Emergency Diesel Fire Pump
	U205 Emergency Diesel Generator - 1675 HP
OS1	Emergency Diesel Generator
	U206 10 Cell Cooling Tower
OS1	Mechanical Draft Cooling Tower (10 Cells)

Table 2: Woodbridge Energy Center Permitted Operating Scenarios

OS#	Emission Unit Description
	U1 Combined Cycle Combustion Units 1& 2
OS1	Turbine 1 firing natural gas at full load with natural gas fired duct burner in HRSG for supplemental firing
OS2	Turbine 1 firing natural gas at full load without supplemental duct burner firing in HRSG
OS5	Turbine 2 firing natural gas at full load with natural gas fired duct burner in HRSG for supplemental firing
OS6	Turbine 2 firing natural gas at full load without supplemental duct burner firing in HRSG
OS3	Turbine 1 Start-up Operation
OS4	Turbine 1 Shut-down Operation
OS7	Turbine 2 Start-up Operation
OS8	Turbine 2 Shut-down Operation
	U3 Gas Fired Auxiliary Boiler
OS1	Gas Fired Auxiliary Boiler
	U4 Diesel Fire Water Pump Engine
OS1	Diesel Fire Water Pump Engine
	U5 Emergency Diesel Generator
OS1	Emergency Diesel Generator
	U6 Cooling Tower – 14 Cells
OS1	Cooling Tower - 14 Cells

The single source modeling results show that the proposed Woodbridge Energy Center/Keasbey Energy Center facility will have significant impact concentrations associated with its 1-hour and annual nitrogen dioxide (NO_2), 24-hour particulate matter (PM) PM-10, and 24-hour and annual PM-2.5 emissions. Submission of a multisource modeling protocol is the next step required for regulatory demonstration. This document represents the modeling methodology to be followed in order to provide the NAAQS and PSD Increment multisource modeling demonstration.

Since total modeled concentrations from the combined Keasbey and Woodbridge facilities were determined to be greater than the significant impact levels (SILs) for 1-hour and annual NO_2, 24-hour PM-10, 24-hour and annual PM-2.5 (see tables below), multisource National Ambient Air Quality Standards (NAAQS) analyses for those pollutants is required. Further, 24-hour PM-10, 24-hour PM-2.5, annual PM-2.5, and annual NO_2 Prevention of Significant Deterioration (PSD) Class II increment analyses will also be performed. Table 3 and Table 4 present the maximum modeled concentrations from the single source modeling analysis for the facility normal operations and the startup/shutdown (SU/SD) operations, respectively.

Table 3: Facility Maximum Modeled Concentrations Due to Normal Operations Compared to the SILs

Pollutant	Averaging Period	Significant Impact Concentration (ug/m³)	Maximum Modeled Concentration (ug/m³)
PM-10	24-Hour	5	9.6[c]
PM-2.5	24-Hour	1.2	7.4[e]
	Annual	0.3	0.41[d]
NO_2	1-Hour	7.5	23.1[a,b]
	Annual	1	1.28[a,c]

Note:
[a] Includes use of PVMRM.
[b] Based upon maximum 1st highest maximum daily 1-hour results averaged over 5-years.
[c] Maximum modeled concentration.
[d] Maximum annual results averaged over 5-years.
[e] Based upon maximum 1st highest 24-hour results averaged over 5-years.

Table 4: Facility Maximum Modeled Concentrations During Startup/Shutdown Compared to the SILs

Pollutant	Averaging Period	Significant Impact Concentration ($\mu g/m^3$)	Maximum Modeled Concentration (ug/m^3)
NO_2	1-Hour	7.5	74.4[a,b,f]
	Annual	1	1.28[a,c]
PM-10	24-Hour	5	9.6[c]
PM-2.5	24-Hour	1.2	7.4[e]
	Annual	0.3	0.40[d]

Note:
[a]Includes use of PVMRM.
[b]Based upon maximum 1st highest maximum daily 1-hour results averaged over 5-years.
[c]Maximum modeled concentration.
[d]Maximum annual results averaged over 5-years.
[e]Based upon maximum 1st highest 24-hour results averaged over 5-years.
[f]Maximum modeled 1-hour NO_2 concentration located 0.6 km from the proposed facility.

<u>Step 1 – Pollutant areas of impact</u>

The first step of conducting a NAAQS/PSD Class II increment analysis is to determine the pollutant specific area(s) of impact of the proposed facility. The area of impact corresponds to the distance at which the model calculated pollutant concentrations fall below the SILs.

The areas of impact for the aforementioned pollutants under normal operations are as follows:

- 24-hour PM-10 AOI = 897 meters;
- 24-hour PM-2.5 AOI = 2,160 meters;
- 1-hour NO_2 AOI = 1,266 meters;
- Annual NO_2 AOI = 266 meters; and
- Annual PM-2.5 AOI = 764 meters.

Figures 1 through 5 graphically present the impact areas associated with the normal operations.

The areas of impact for the aforementioned pollutants under startup/shutdown operations are as follows:

- 24-hour PM-10 AOI = 897 meters;
- 24-hour PM-2.5 AOI = 2,598 meters;
- 1-hour NO_2 AOI = 50,000 meters;
- Annual NO_2 AOI = 266 meters; and
- Annual PM-2.5 AOI = 809 meters.

Figures 6 through 10 graphically present the impact areas associated with the startup/shutdown operations.

Step 2 – Off-site major source emission inventories

The second step is obtaining off-site major source inventories within the area of impact plus a distance to be determined based upon discussions with NJDEP. Included with the initial single source modeling approval memo on November 20, 2017, the NJDEP provided lists of major sources to be evaluated in the multisource modeling. The Department provided major sources to be included in the NAAQS and PSD increment modeling for those pollutants and averaging periods that resulted in concentrations greater than the SILs. Subsequently, with the updated single source modeling approval on August 6, 2021, the NJDEP provided an updated list of sources to be considered for the NAAQS compliance demonstrations.

As noted in the single source approval letter on August 6, 2021, the significant impact areas for annual NO_2, PM-2.5, and PM-10 are such small extents that there are no major sources found within their radii. Additionally, the NJDEP indicated that only 1 source of PM-2.5 is located within 10 km of the facility for inclusion into the emission inventory for 24-hour PM-2.5 compliance demonstrations. As such, the annual PM-2.5, and PM-10 NAAQS and PSD Class II increment, and annual NO_2 PSD Class II increment compliance demonstrations will not include offsite sources. The 24-hour PM-2.5 NAAQS compliance demonstration will include AES Red Oak (PI# 18195) as provided in the single source modeling approval on August 6, 2021.

As the Department provided on August 6, 2021, 85 offsite facilities to potentially include in the 1-hour NO_2 major source modeling analysis, subsequent screening of these facilities was performed to reduce the number of sources/emission points to be included in the 1-hour NO_2 NAAQS assessment. This screening procedure is described in detail in Section 2.0 Screening of NO_2 Sources, and Appendix A of this document.

The proposed off-site major sources will be included in the NAAQS modeling analysis along with the sources at the proposed Keasbey facility and existing Woodbridge facility. The Keasbey Energy Center and Woodbridge Energy Center sources to be included in the multisource modeling analyses are as follows:

- Keasbey: 1 combustion turbine, 1 auxiliary boiler, 1 DFP, 1 EDG, 10-cell cooling tower
  - Operating Scenarios to be modeled:
  - CT: OS1, OS2, OS4, OS5
  - DFP: OS1
  - EDG: OS1
  - Cooling Tower: OS1
- Woodbridge: 2 combustion turbines, 1 auxiliary boiler, 1 DFP, 1 EDG, 14-cell cooling tower
  - CT1 & CT2: OS1, OS2, OS3, OS4, OS5, OS6, OS7, OS8
  - DFP: OS1
  - EDG: OS1
  - Cooling Tower: OS1

The resultant concentrations will then be added to the representative background concentration for comparison to the NAAQS. If the modeled concentration plus the background concentration is less than the NAAQS, the proposed facility air quality impact is considered acceptable relative to the NAAQS. CPV Keasbey, LLC will demonstrate that its modeled impact plus representative background concentrations will be in compliance with the NAAQS.

To conservatively assess the cumulative PSD increment concentrations, the modeled contributions from the proposed offsite inventory will be determined. In the event the conservative concentration exceeds the PSD increment, only those sources which were permitted or had a major modification after the baseline date will be evaluated. The highest second-highest cumulative concentrations will be compared to the 24-hour PM-10 and 24-hour PM-2.5 Class II increments, respectively. If the highest second-highest short-term modeled concentrations are less than the PSD Class II increments, the proposed facility air quality impact is considered acceptable relative to the PSD Class II increments. Additionally, the maximum modeled annual concentrations will be compared to the annual PM-2.5 and annual NO_2 Class II increments. If the maximum annual modeled concentrations are less than the PSD Class II increments, the proposed facility air quality impact is considered acceptable relative to the PSD Class II increments.

The following section outlines the proposed modeling methodologies that will be followed along with a summary spreadsheet presenting source locations and base elevations, stack parameters, and emissions for each source.

2.0 Screening of NO_2 Sources

Accompanying the single source approval memorandum issued by NJDEP on November 20, 2017, the Department provided a list of ninety-five (95) major NO_2 facilities located in New Jersey to be evaluated for inclusion in the multisource NO_2 modeling analysis. Subsequently, on August 6, 2021, the NJDEP provided an updated list of eight-five (85) major NO_2 facilities located in New Jersey to be evaluated for inclusion into the multisource modeling analysis. Note that any sources that were included in the initial sources list from 2017 but were excluded from the source list in 2021 will be excluded from the multisource modeling analysis. In addition to the New Jersey sources, the NYSDEC Major Source Permits website was searched to obtain those sources on Staten Island (in close proximity to the proposed facility) which likewise would be evaluated for inclusion in the NO_2 modeling.

The major sources located on Staten Island included:

- NRG Arthur Kill Station - Permit ID: 2-6403-00014/00031
- Fresh Kills Landfill - Permit ID: 2-6499-00029/00151
- NYPA Pouch Terminal - Permit ID: 2-6402-00295/00003

The addition of the New York sources resulted in an initial set of eighty-eight (88) NO_2 sources to evaluate for developing the NO_2 offsite major source modeling inventory. These sources are identified by a "map number", denoting the location of each source on a map of the study area provided on Figure A-1 located in Appendix A, as well as on supporting figures referenced within this text.

In order to accurately obtain the permitted emissions and exhaust parameters necessary for performing the air quality modeling, NJDEP OPRA requests were submitted to obtain the RADIUS permit electronic import files, in order to ascertain the individual emission units, operating scenarios, emissions and source parameters. In addition, the latest Title V permit files were downloaded from the OPRA website. The emissions from the Keasbey and Woodbridge Energy Centers will be modeled at their allowable (permitted) emissions rates. Likewise, the modeling of offsite major sources initially will be evaluated using their permitted emissions.[1] Modeling offsite sources at their allowable emission rates provides a

[1] It should be noted that while the modeling guidance recommends accounting for actual operations, the nature of obtaining the facility emissions from the RADIUS electronic permits provides the *permitted* operations which, in practice, are used for assessing the cumulative air quality impacts. Use of actual emissions will be a refined modeling technique in order to resolve any modeled exceedances of the NAAQS or PSD increment.

significant level of conservatism to the NAAQS assessment. In the event this additional level of conservatism become problematic with demonstrating compliance with the 1-hour NO_2 NAAQS, emission statements may be used to determine the actual emissions for assessing the cumulative impact of specific sources. Use of actual emissions will be reviewed and approved by the reviewing agencies prior to any subsequent refined modeling of exceedances.

Upon review of the NJ permit files, Program ID (PID) 40009 for Merck Dohme facility in Rahway was determined to have been terminated and incorporated in PID 41712. Also, Program ID (PID) 19149 for the Middlesex Energy Center was determined to be canceled. This resulted in an initial working set of eighty-six (86) sources to evaluate and reduce to a manageable NO_2 modeling inventory. The initial inventory of NO_2 sources being evaluated is presented in Table 6. This source evaluation exercise is accomplished through a methodical four-step process described as follows:

- Step 1: By agreement with NJDEP, eliminate sources at and beyond 50 kilometers from KEC.
- Step 1A: Retain all sources considered “nearby”, which are sources located within fourteen (14) kilometers of the proposed facility.
- Step 2: Perform an AERSCREEN analysis and eliminate any sources which have no significant impacts (i.e., maximum concentration is less than 7.5 micrograms per cubic meter (ug/m^3)).
- Step 3: Eliminate sources which would be included in the background concentrations, based on proximity and location to ambient air quality monitors.
- Step 4: Eliminate sources whose significant impact areas would not overlap with the proposed SIA.

To assist with the evaluation of Step 3, Figure 11 presents a Wind Rose based on Newark Airport data for the period 2013-2017. As shown, the predominant wind directions (from which the wind is blowing) are from the southwest through the northwest, with a secondary northeast component. What is also important to note is that the wind also has a measurable frequency in the directions from the northeast through to the southwest which will direct emissions towards monitors located towards the south and southeast.

2.1 Step 1

Per discussions with the Department, the initial list of NJ sources was created by extracting sources on a county basis. As such, the initial list included sources beyond the inventory development distance of 50 kilometers. These sources with their associated map numbers are identified on Figure 12 and as Figure A-1 in Appendix A. The initial list was tabulated to include distance and direction from the KEC/WEC facility. Those sources located at and beyond 50 kilometers were removed from further consideration. Upon review of the sources, it was noted that several were located slightly less than 50 kilometers, and as such, the first step screening criteria was to remove all sources greater than 48 kilometers distance. The first step removed seven (7) sources from consideration, leaving seventy-nine (79) sources for subsequent evaluation. The sources removed in this step are summarized in Table 7.

2.2 Step 1A

The first step also categorically determines that any source located within fourteen (14) kilometers of the KEC/WEC facility would be considered as "nearby" and will be retained in the 1-hour NO_2 modeling inventory, unless otherwise determined to result in insignificant air quality impacts, which would result from the next step. The 14-kilometer radius was selected as the distance to the nearest group of sources whose emissions would be represented by the Elizabeth (and adjacent) monitors. This distance is indicated by the red ring around the KEC/WEC facility on Figure 12. The sources located within 14 kilometers are summarized in Table 8.

2.3 Step 2

In order to determine the potential air quality impacts from the sources being evaluated, AERSCREEN was used to calculate the maximum concentrations from each of the sources. AERSURFACE was used to determine the land use surface characteristics for each source being screened. The maximum concentrations were ranked and those sources with concentrations less than 7.5 ug/m^3 were eliminated from further consideration. Table 9 presents the AERSCREEN modeling results ranked in order of maximum concentration for those sources which resulted in insignificant concentrations. Note that while the sources Sewaren Generating Station, Bayshore Recycling, and CMC Steel New Jersey resulted in insignificant NO_2 concentrations, these particular sources were considered sufficiently important and nearby KEC to be included in the NO_2 modeling inventory, and as such were retained.

2.4 Step 3

NJDEP operates a comprehensive and robust ambient air quality monitoring network, which encompasses and represents the air quality concentrations associated with many of the proposed major NO_2 sources. The highest monitoring concentrations from each of five (5) existing 1-hour NO_2 monitors were assessed to develop a single set of 1-hour NO_2 background concentrations on a season and hour of day basis which is proposed for use in the cumulative NO_2 impact modeling. The NO_2 monitoring data for 2017, 2018 and 2019 are summarized for these five (5) monitors and presented in ppb and ug/m^3 as Tables 10A and 10B, respectively. The data provided in these two tables are for illustrative purposes only. The NO_2 background concentrations proposed for including with the modeled NO_2 concentrations are based on these same monitoring data and will be summarized into a seasonal and hour of day format for input to the AERMOD model, in accordance with U.S. EPA modeling guidance. This methodology is discussed in depth later in this protocol, which results in background values that are very conservative for the majority of the modeling domain, given that the maximum concentration from the five (5) monitors was utilized to represent the entire modeling domain as discussed in Section 3. This step identifies those sources which are in close proximity to the ambient monitors, or where the emissions would clearly be in line with a monitor between the source and KEC/WEC. The seasonal and hour of day summary worksheets are provided on the DVD in Appendix A.

The current EPA Appendix W modeling guidance recommends that sources which would be included in the background air quality should not be included in the modeling inventory. The purpose is to avoid double counting of concentrations and skewing the modeled impact of facilities on the NAAQS. The list of NO_2 sources were evaluated as to their proximity to existing ambient air quality monitors. NJDEP operates four (4) ambient monitors which are located towards the northeast of the CPV Keasbey facility. A fifth monitor is located in New Brunswick and west of the facility. Figure 13 illustrates the relationship of the Elizabeth, Newark and Bayonne monitors to sources selected as being represented in the background monitoring data. Likewise, Figure 14 illustrates the relationship of the Newark, Fort Lee and Bayonne monitors relative to the location of sources located further towards the northeast from the CPV Keasbey facility. These monitors effectively encompass the sources nearby and during the course of any given year will record the emissions of the nearby sources. As such, the sources identified in Table 11 were eliminated from the list of NO_2 sources as contributing to the background.

2.5 Step 4

The last step in the evaluation process determines if a source results in significant air quality concentrations that will overlap with the significant impact concentrations from the KEC/WEC sources. This step was accomplished by performing a refined five-year hourly modeling analysis along a line of receptors from each specific source being examined in Step 4 towards the KEC/WEC location. For each source, the line of 250 receptors were generated at 250 meter spacing and the actual terrain elevations were determined using AERMAP. The sources were evaluated using AERMOD with PVMRM, ozone data, and in-stack (NO_2/NO_x) and ambient ratios of 0.2 and 0.9, respectively. Modeling guidance recommends using an in-stack ratio of 0.2 for sources beyond several kilometers. Inasmuch as the sources being evaluated in Step 4 are greater than 14 kilometers distant, use of 0.2 is appropriate for this evaluation modeling exercise. The list of sources evaluated and eliminated by Step 4 are presented in Table 12. Likewise, graphically, the NO_2 significant impact areas are presented on Figure 15 (NO_2 Inventory Screening Map) and on Figure A-1 as blue rings around each source. A legend sheet explaining the drawing details is included in Appendix A. Several sources resulted in no significant concentrations and consequently would have no SIA and would be eliminated.

2.6 Step 5 - Development of NO_2 Modeling Inventory

The 4-Step process described above is integrated into a single Excel worksheet. Each of the "cuts" in the initial inventory are identified in a separate column. Any individual source which survives all four "cuts" would be included in the off-site inventory for NO_2 NAAQS modeling. While the inventory evaluation process is prescriptive in nature (i.e., methodical), there is subjectivity in the exclusion (or inclusion) of sources. As such, the final development of the inventory relies upon good modeling and engineering judgement to "fine-tune" and either add or eliminate sources. Specifically this judgement was applied to retaining sources within 14 kilometers which resulted in insignificant concentrations in the Step 2 AERSCREEN analysis. Namely, these sources are CMC Steel New Jersey, Bayshore Recycling, and Sewaren Generating Station. The Excel worksheet is provided to the Department for review. Finally, sources to the west of the KEC/WEC facility that are not represented in background data and located in or near the Watchung Mountains were included in the final inventory due to their proximity to the location of the KEC/WEC maximum concentration (during startup conditions). These are:

- #33 COVALENCE SPECIALTY ADHESIVES LLC
- #38 NEW JERSEY AMERICAN WATER CO
- #48 CIP II/AR BRIDGEWATER HOLDINGS LLC

The resulting inventory of thirty-three (33) NO_2 major sources proposed for the 1-hour NO_2 cumulative NAAQS modeling is presented in Table 13. Figure 16 provides a map showing the locations of these sources relative to the ambient monitors and the KEC/WEC facility. The entire screening process worksheet is provided in Appendix A, along with the screening modeling files on a DVD.

3.0 Proposed Modeling Methodology

Multisource air quality dispersion modeling will be performed consistent with the procedures found in the following documents: Guideline on Air Quality Models (Revised) (U.S. EPA, 2017), New Source Review Workshop Manual (U.S. EPA, 1990), Screening Procedures for Estimating the Air Quality Impact of Stationary Sources (U.S. EPA, 1992), Guidance on Preparing an Air Quality Modeling Protocol - Technical Manual 1002 (NJDEP, 2018), and the final version of the Keasbey Energy Center Air Quality Modeling Protocol submitted on February 18, 2021 and conditionally approved by the NJDEP on April 19, 2021.

PSD Increment Baseline Dates

The PM-2.5 New Jersey minor source baseline dates for the New Jersey Portion of the New York - New Jersey - Connecticut Interstate Air Quality Control Region (Bergen, Essex, Hudson, Middlesex, Monmouth, Morris, Passaic, Somerset, and Union Counties) are:

- September 4, 2013 (PM-2.5 Attainment Re-designation)
- February 1, 2016

The PSD minor source baseline date for NO_2 is February 8, 1988 for all areas of New Jersey.

The New Jersey major source baseline dates are as follows:

- PM-10 - August 6, 1975
- NO_2 - February 8, 1988
- PM-2.5 - October 20, 2010

Background Ambient Air Quality

Background ambient air quality data was obtained from various approved existing monitoring locations. These monitors have been designed, sited, and operated in accordance with U.S. EPA monitoring guidelines in terms of quality assurance and quality control of the data collection and the reliability of the data itself which are outlined at the EPA's Report on the Environment website https://www.epa.gov/report-environment. This website documents the QA/QC components of the data collection process.

Based on review of the locations of NJDEP ambient air quality monitoring sites, the closest NJDEP monitoring sites were used to represent the current background air quality in the site area. Background data for PM-10 was obtained from a Jersey City monitoring station located in Hudson County, New Jersey (EPA AIRData # 34-017-1003), approximately 32 km northeast of the proposed facility. The monitor is located at 355 Newark Avenue in a commercial/urban area. This monitor is located in an area with a greater amount of mobile and point sources of air emissions as compared to the project area. Thus, this monitor would be considered to conservatively represent the ambient air quality within the project area.

Background data for NO_2 was obtained from an East Brunswick monitoring station located in Middlesex County, New Jersey (EPA AIRData # 34-023-0011), approximately 11 km west-southwest of the proposed facility. The monitor is located at Rutgers University (Veg. Research Farm #3 on Ryders Lane) in an agricultural/rural area with proximate commercial uses (i.e., Route 1 and Interstate 95). This monitor's close proximity to the Project site would qualify it to be representative of the ambient air quality within the project area.

Background data for PM-2.5 was obtained from an East Brunswick Township monitoring station located in Middlesex County, New Jersey (EPA AIRData # 34-023-0011), approximately 10 km west-southwest of the proposed facility. The monitor is located at Rutgers University's Cook College (67 Ryders Lane) in an agricultural/rural area with proximate commercial uses. This monitor's close proximity would qualify it to be representative of the ambient air quality within the project area.

A summary of the monitoring data for the recent three years (2017 – 2019) are presented and compared to the NAAQS in the table below. The maximum measured concentrations for each of these pollutants during the last three years are all below applicable standards and are proposed to be used in the multisource NAAQS analysis as representative background concentrations. Table 5 is a summary of the maximum measured air quality concentrations and Table 14 provides the details and stations used to develop these background air quality value. Note that seasonal and hour of day NO_2 concentrations will be used with the 1-hour NO_2 modeling assessment, as discussed in detail in the next section.

Table 5: Summary of Maximum Measured Ambient Air Quality Concentrations

Pollutant	Averaging Period	Maximum Ambient Concentrations (μg/m³)			NAAQS (μg/m³)
		2017	2018	2019	
NO_2	Annual	15.0	15.0	**16.9**	100
PM-10	24-Hour	32	**33**	**33**	150
PM-2.5[a]	24-Hour	18.8	18.6	17.1	35
	Annual	8.3	8.0	7.9	12

[a]24-hour 3-year average 98th percentile design value for PM-2.5 is **18.2** μg/m³; Annual 3-year average value for PM-2.5 is **8.1** μg/m³.
High second-high short term for (24-hour) and maximum annual average concentrations presented for all pollutants other than PM-2.5.
Bold values represent the proposed background values for use in comparing facility concentrations to the NAAQS.
Monitored background concentrations obtained from the U.S. EPA AIRData, AirExplorer and Air Quality System (AQS) websites.

1-Hour NO_2 Modeling Methodology and Background Data

The air quality modeling analysis for the 1-hour NO_2 NAAQS will be performed consistent with the guidance and procedures established and in the revised "Guideline on Air Quality Models" (January 17, 2017), the September 30, 2014 guidance memorandum from Mr. Chris Owen and Mr. Roger Brode (EPA AQ Modeling Group) titled "Clarification on the Use of AERMOD Dispersion Modeling for Demonstrating Compliance with the NO_2 National Ambient Air Quality Standard", and the March 1, 2011 guidance memorandum from Mr. Tyler Fox (EPA OAQPS) titled "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-Hour NO_2 NAAQS".

The proposed 1-hour NO_2 modeling approach is to combine monitored background and modeled concentrations by season and hour-of-day pairing option provided by AERMOD. As stated in the Memorandum:

> *"We believe that an appropriate methodology for incorporating background concentrations in the cumulative impact assessment for the 1-hour NO_2 standard would be to use multiyear averages of the 98^{th}-percentile of the available background concentrations by season and hour-of-day..."*
>
> *"...we recommend that background values by season and hour-of-day used in this context should be based on the 3^{rd} highest values for each season and hour of day combination , whereas the 8^{th}-highest value should be used if values vary by hour-of-day only...."*

Thus, the demonstration of the 1-hour NO_2 NAAQS, by combining monitored and modeled concentrations will be accomplished on an hour-of-day by season approach. The hour-of-day monitored concentrations will be divided by season for each year and then those seasonal groups will be further binned into 24 hour-of-day groups for a total of 96 bins of values (product of 4 seasons and 24 hours) for each year. The 3^{rd} highest value from each bin will then be found per year. Finally, to obtain the values to be summed with the modeled concentrations, the average of those 3^{rd} highest values will be taken over a three year period. This methodology results in a set of 96 three (3) year average 98% background values by hour-of-day and season for each of the five (5) stations examined. The final step uses the highest value within each of the 96 values determined for each station to create the background data as input to AERMOD. This resulted in a composite worst-case seasonal hour of day background that can be added to the modeled concentrations for comparison with the 1-hour NO_2 NAAQS using the BACKGROUND keyword in AERMOD. The raw AIRData files along with the Excel workbooks used to create the seasonal hour of day summaries are provided as data files on the DVD in Appendix A.

As discussed in Section 2, the monitoring concentrations from five (5) existing 1-hour NO_2 monitors were assessed to develop a single set of 1-hour NO_2 background concentrations on a season and hour of day basis. The following monitors were assessed and the maximum reported value was conservatively used to develop a single set of season and hour of day values for the entire modeling domain.

#1	ID: 34-003-0010 - Bergen Co - Fort Lee.
#2	ID: 34-013-0003 - Essex Co - Newark.
#3	ID: 34-017-0006 - Hudson Co - Bayonne.
#4	ID: 34-023-0011 - Middlesex Co - East Brunswick.
#6	ID: 34-039-0004 - Union Co - Elizabeth.

The monitor located in Chester, NJ was initially identified as #5, but was subsequently removed as being located too distant to adequately represent background air quality. Figure 16 provides the location of the five (5) monitors; the locations of the facilities selected for the 1-hour NO_2 modeling assessment; and the KEC/WEC facility location. The seasonal and hour of day background values were developed by initially downloading the hourly monitoring values for each of these stations, inputting into Excel and by sorting and binning these values into the 96 three (3) year average values as described previously. Table 15 presents the highest seasonal and hour of day values for these stations. The stations providing the highest concentration for each cell are color coded and shown in a legend on this table. The data files and Excel workbooks have been provided to both NJDEP and EPA for review, and are included on the supporting data files DVD.

On June 21, 2017, CPV Keasbey requested approval from U.S. EPA Region 2 to use the Tier 3 modeling approach for 1-hour NO_2 modeling assessment results using the Plume Volume Molar Ratio Method (PVMRM) which adjusts NO_x emissions to estimate more realistic ambient NO_2 concentrations by modeling the conversion of NO_x to NO_2. Approval was granted by NJDEP on July 19, 2017. A default value of 0.5 will be used as the in-stack ratio (ISR) of NO_2/NO_x while a default value of 0.90 will be used as the ambient equilibrium ratio for the KEC/WEC sources while for the cumulative NAAQS modeling of offsite NO_2 sources greater than 3 kilometers, an ISR of 0.2 will be used.[2]

Treatment of Intermittent Sources

Based upon the discussion in the Memorandum regarding the treatment of intermittent sources, it is proposed that only offsite sources or operating scenarios that "are continuous or

[2] Clarification on the Use of AERMOD Dispersion Modeling for Demonstrating Compliance with the NO2 National Ambient Air Quality Standard. R. Chris Owen and Roger Brode. U.S.EPA. September 20, 2014.

frequent enough to contribute significantly to the annual distribution of daily maximum 1-hour concentrations" be included in the 1-hour NO_2 modeling analysis.

This methodology, per the examples provided in the Memorandum, would exempt any Facility equipment or operating scenarios from 1-hour NO_2 compliance modeling that does not operate on a normal daily or routine schedule. For example, emergency equipment is not expected to be routinely tested more than once per week for more than one-half hour and thus, would not be expected to contribute significantly to the annual distribution of maximum concentrations. For these reasons, consistent with the Memorandum, it is proposed that the 1-hour NO_2 modeling will not include any emergency equipment at any of the thirty-three (33) facilities proposed in the 1-hour NO_2 cumulative inventory.

24-Hour PM-2.5 Modeling Methodology

The modeling assessment for PM-2.5 will follow the guidance and procedures established in the May 20, 2014 guidance memorandum from Stephen D. Page (EPA) titled "Guidance for PM-2.5 Permit Modeling". Compliance with the PM-2.5 NAAQS may be demonstrated by calculating the five-year average of the maximum 24-hour average PM-2.5 prediction at any receptor and then this value is added to the 3-year average 98^{th} percentile 24-hour background value from a representative PM-2.5 monitor and compared to the 24-hour NAAQS. The five-year average maximum modeled 24-hour PM-2.5 value will be added to the 3-year average 98^{th} percentile 24-hour background value from a representative PM-2.5 monitor (i.e., the Middlesex County monitor in New Brunswick, with a 3-year average 98^{th} percentile value of 18.2 $\mu g/m^3$) and compared to the 24-hour PM-2.5 NAAQS. A "first tier" demonstration of the 24-hour PM-2.5 NAAQS is proposed by adding the 3-year average 98^{th} percentile 24-hour background concentration with the maximum five-year 24-hour PM-2.5 modeled concentrations.

Annual PM-2.5 Modeling Methodology

The modeling assessment for PM-2.5 will follow the guidance and procedures established in the May 20, 2014 guidance memorandum from Stephen D. Page (EPA) titled "Guidance for PM-2.5 Permit Modeling". The multisource modeling analysis will be conducted for all receptors located within the significant impact area (SIA) (i.e., 800 meters from the Project location). Compliance with the PM-2.5 NAAQS may be demonstrated by calculating the highest average of the modeled annual averages across five-years of meteorological data at any receptor and then this value is added to the 3-year average of the annual mean concentration background value from a representative PM-2.5 monitor and compared to the annual NAAQS. The highest average of the modeled annual average across the five-years of meteorological data will be added to the 3-year average of the annual mean concentration background value from a representative PM-2.5 monitor (i.e., the Middlesex County monitor in New Brunswick, with an annual 3-year average value of 8.1 μg/m³) and compared to the annual PM-2.5 NAAQS.

24-Hour PM-10 Modeling Methodology

Multiple source modeling for 24-hour PM-10 will be performed to assess the impacts of the Project plus other sources of PM-10 in the surrounding region. Multiple source impacts will be determined from modeling the sources at the Keasbey facility, the Woodbridge facility, and the offsite sources.

The multisource modeling analysis will be conducted for all receptors located within the significant impact area (SIA) (i.e., 897 meters from the Project location). The maximum modeled multiple source impacts for PM-10 will be summarized in a table, showing that the modeled concentration from all sources combined, plus the highest second-highest ambient background, is below the 24-hour PM-10 NAAQS of 150 μg/m³. In the event this conservative approach shows modeled exceedances, the highest 6th highest predicted 24-hour multisource concentration can be used for comparison with the 24-hour PM-10 NAAQS.

Receptor Grid

Part of the AERMOD package, the receptor-generating program, AERMAP (version 18081) was used to develop a complete 20 km (east-west) x 20 km (north-south) rectangular (i.e., Cartesian) receptor grid (e.g., fine grid receptors < 100 meters), centered on the proposed facility, to assess the air quality impact for the criteria pollutants other than 1-hour NO_2. Likewise, a 50 km receptor grid was developed to assess the combustion turbine startup and shutdown NO_2 concentrations. Only those receptors which exhibited concentrations equal to and greater than the NO_2 SIL will be assessed for the 1-hour NO_2 NAAQS. A figure illustrating the NO_2 inventory sources and these receptors is provided in Appendix A as Figure A-2.

Per the September 30, 2014 and March 1, 2011 EPA memorandums, the receptor grid for modeling of the 1-hour NO_2 NAAQS can be limited to those receptors where the Project's five (5) year receptor specific maximum modeled impacts exceed the 1-hour NO_2 SIL (see Figure A-2). Also, if any violations of the 1-hour NO_2 NAAQS are modeled at any of those remaining receptors, the Project's contributions to each of those violations should be determined. For a given NAAQS and corresponding SIL, a modeled contribution that is less than the SIL is not considered to cause or contribute to a modeled violation of the NAAQS. Thus, the multisource 1-hour NO_2 NAAQS analysis for startup and shutdown operations will be conducted using a receptor grid comprised only of those receptors that have five (5) year average maximum modeled 1-hour NO_2 impacts above the SIL.

The receptor grid for modeling of the PM-2.5 and PM-10 NAAQS will be based upon the single source receptor grid out to a distance from the WEC/KEC facility of 3 kilometers. A 3-kilometer grid conservatively includes all of the receptors with modeled impacts above the SILs, with the exception of 1-hour NO_2 as discussed above.

Building Downwash

NJDEP and U.S. EPA Region II require the air quality assessment to demonstrate compliance with the NAAQS and PSD increments to incorporate building downwash. This requirement is reasonable for the applicant source, which has the ability to accurately determine the building dimensions necessary to accurately develop the building downwash parameters required for modeling. Likewise, off-site facilities which have been required to perform an air quality modeling assessment within the past few years will have used building downwash in their respective air quality modeling analyses[3]. To the extent they were available, these building downwash modeling inputs have been provided by the NJDEP, and with one exception will be included in the multisource modeling analysis.[4] However, for off-site sources which may not have performed a recent modeling analysis which included downwash model inputs, obtaining the building dimensions necessary to accurately include the building downwash parameters is problematic. CPV will use the building downwash parameters for the KEC and WEC facilities which have been developed for the single source modeling analysis. CPV evaluated other "nearby" sources and for those sources which are readily mapped has obtained the building dimensions through measurements made using Google Earth™ imagery. Downwash parameters were not able to be used for off-site facilities which do not have any substantive structures; are too complex to accurately define the structures for BPIP; or, where the locations of the emission units were not identified. The BPIP files for developing the building downwash modeling parameters are included on the accompanying DVD.

[3] These downwash files can be used provided that the downwash parameters apply to the emission unit being modeled in the cumulative impact modeling analysis. See note 6.

[4] One source (Buckeye Port Reading) with downwash parameters provided by NJDEP from a recent modeling analysis did not represent the specific emission units used in the NO_2 multisource inventory and as such were not appropriate for use in the multisource modeling assessment.

4.0 Proposed Emission Inventory Sources

Based upon the sources recommended by NJDEP for inclusion in the multisource inventory for PM-10 and PM-2.5, plus the 33 NO_2 sources identified for inclusion based on screening of NJDEP's original list of NO_2 sources, Table 16 presents a matrix of thirty-three (33) sources and associated pollutants, proposed to be included in the multisource modeling.

Table 17 provides a summary of the facility emissions and exhaust parameters that are proposed to be included in the multisource NAAQS and PSD Class II increment modeling analyses.

4.1 Keasbey Energy Center and Woodbridge Energy Center Sources

Of the sixteen (16) operating scenarios previously modeled for the Keasbey Energy Center single source modeling assessment, the worst case operating scenarios (i.e., operating scenarios which yielded the maximum modeled concentrations) were:

- Case 11 (all pollutants and averaging periods)

Of the fourteen (14) operating scenarios previously described for the Woodbridge Energy Center, the worst case operating scenarios (i.e., operating scenarios which yielded the maximum modeled concentrations) were:

- Case 7 (1-hour NO2); and,
- Case 9 (24-hour PM-10, annual NO2, 24-hour PM-2.5, and annual PM-2.5)

These worst case operating conditions for the KEC/WEC emission units will be assessed accordingly with the major source inventory as previously described. The worst case operating conditions with emissions and emission parameters and the SU/SD modeling methodologies are provided in Tables 18 through Table 26, which were previously provided in the support document for the CPV Keasbey single source modeling assessment. The emissions and emission parameters for the facility ancillary equipment are included on tables provided in Appendix A.

5.0 Multiple Source Impact Modeling Results

NAAQS Compliance Modeling

Air Quality Model and Meteorology

Air Quality Model AERMOD Version 21112 is proposed for assessing the NAAQS and PSD increment cumulative impacts. Note that the AERMOD model (Version 19191) will be utilized for model runs that include background air quality concentration data (i.e., 1-hour NO_2) based on model coding errors contained within AERMOD model (Version 21112) for modeling of background air quality data. Meteorology from Newark airport for the period 2013-2017 has been processed using AERMET 18081 by NJDEP and provided to the Applicant for use. These data are proposed for use with the modeling assessment.

Urban Source Option

The URBANOPT keyword on the CO pathway in AERMOD, coupled with the URBANSRC keyword on the SO pathway, may be used to identify sources to be modeled using the urban algorithms in AERMOD. This option is available to model specific offsite sources which may be influenced by an urban heat island effect, even if the overall study area is considered to be rural. The KEC/WEC sources have previously been demonstrated to be in an area where rural dispersion characteristics would apply. The land use characteristics for other offsite sources north of Middlesex County and on Staten Island would qualify as having urban dispersion characteristics, therefore the URBANSRC option is proposed for use with the major sources, identified as such on Table 13.

Compliance Modeling Methodology

NAAQS compliance modeling is performed by assessing the cumulative impact of the KEC/WEC facility with the major sources and with a representative background. The permitted emissions from the off-site major sources will be used in the initial assessment. The methodology is to first examine if an exceedance of NAAQS occurs, and if so, how many exceedances occur during the modeling period. This is achieved by initially running AERMOD with all sources for all receptors within the study area (for the specific pollutant and averaging period.) If the analysis determines there are no exceedances of the NAAQS, the analysis is complete. However, if exceedances are determined, the second step is to reevaluate the sources with those specific exceedance receptors using the AERMOD MAXDCONT (maximum daily contributions) option. MAXDCONT, applicable to 24-hour PM2.5, and 1-hour NO_2 concentrations is used to determine the contribution of each user-defined source group to the high ranked values for a target group, paired in time and space. This is accomplished as an internal post-processing routine after the main model run is completed. The source contributions will be further examined to determine if the applicant source significantly contributes to any exceedance. In such cases where the analysis has used conservative modeling conditions, e.g., on-property receptors, permitted vs. actual emissions, conservative background vs. representative background, approved modeling techniques will be applied in order to minimize the conservatism in the analysis. The Department will be advised in such cases in order to discuss and to provide guidance to help resolve any such exceedances. The Applicant understands that the use of actual emissions as a refined modeling technique will be reviewed and approved by the reviewing agencies prior to subsequent refined modeling.

Annual Compliance Modeling Methodology

A conservative approach will be used to assess annual compliance with the NAAQS. The modeling of the annual averages will be performed using the short-term emission rates and if compliance is demonstrated, the annual analysis is complete. In the event the annual NAAQS show modeled exceedances, then refined modeling techniques will be applied. Such techniques would use the permitted annual emissions (permitted OS Summary) values, rather than the worst-case short-term emissions. Other techniques may include using actual annual emissions. The use of actual emission will require review and approval by the reviewing agencies prior to any modeling to resolve exceedances. The sources proposed for the 1-hour NO_2 modeling analysis and for the 24-hour PM modeling analyses will conservatively be utilized for modeling the annual compliance modeling.

24-Hour PM-2.5 NAAQS Compliance

Multiple source modeling will be performed to assess the impacts of the Project plus other sources of PM-2.5 in the surrounding region. Multiple source impacts will be determined by modeling Keasbey (the combustion turbine, auxiliary boiler, emergency diesel generator, emergency diesel fire pump, and wet mechanical draft cooling tower), Woodbridge (the combustion turbines, auxiliary boiler, emergency diesel generator, emergency diesel fire pump, and wet mechanical draft cooling tower), and offsite sources.

The multisource modeling analysis will be conducted for all receptors located within the SIA greater than or equal to the SIL. The maximum modeled multiple source impacts for PM-2.5 will be summarized in a table, showing that the modeled concentration from all sources combined, plus ambient background, is below the 24-hour PM-2.5 NAAQS of 35 $\mu g/m^3$.

Annual PM-2.5 NAAQS Compliance

Multiple source modeling will be performed to assess the impacts of the Project plus other sources of PM-2.5 in the surrounding region. Multiple source impacts will be determined by modeling Keasbey (the combustion turbine, auxiliary boiler, emergency diesel generator, emergency diesel fire pump, and wet mechanical draft cooling tower), Woodbridge (the combustion turbines, auxiliary boiler, emergency diesel generator, emergency diesel fire pump, and wet mechanical draft cooling tower), and offsite sources.

The multisource modeling analysis will be conducted for all receptors located within the SIA (i.e., 800 meters from the Project location). The maximum modeled multiple source impacts for PM-2.5 will be summarized in a table, showing that the modeled concentration from all sources combined, plus ambient background, is below the annual PM-2.5 NAAQS of 12 $\mu g/m^3$.

24-Hour PM-10 NAAQS Compliance

Multiple source modeling will be performed to assess the impacts of the Project plus other sources of PM-10 in the surrounding region. Multiple source impacts will be determined by modeling Keasbey (the combustion turbine, auxiliary boiler, emergency diesel generator, emergency diesel fire pump, and wet mechanical draft cooling tower), Woodbridge (the combustion turbines, auxiliary boiler, emergency diesel generator, emergency diesel fire pump, and wet mechanical draft cooling tower), and offsite sources.

The multisource modeling analysis will be conducted for all receptors located within the SIA (i.e., 897 meters from the Project location). The maximum modeled multiple source impacts for PM-10 will be summarized in a table, showing that the modeled concentration from all sources combined, plus ambient background, is below the 24-hour PM-10 NAAQS of 150 $\mu g/m^3$.

1-Hour NO_2 NAAQS Compliance

Multiple source modeling under startup/shutdown conditions will be performed to assess the worst-case impacts of the Project plus other sources of NO_2 in the surrounding region. Multiple source impacts will be determined by modeling Keasbey (the combustion turbine and auxiliary boiler), Woodbridge (the combustion turbines and auxiliary boiler), and offsite sources.

The multisource modeling analysis will be conducted using a receptor grid comprised only of those receptors that have five (5) year average maximum modeled 1-hour NO_2 impacts above the SIL (i.e., SIA of 50 kilometers from the Project location, as discussed previously). The maximum modeled multiple source impacts for NO_2 will be summarized, showing the modeled concentration from all sources combined with ambient background. The source contribution from KEC/WEC will be provided for any cumulative concentrations in excess of the 1-hour NO_2 NAAQS. The 1-hour NO_2 concentrations will be added to the conservative seasonal and hour of day background data, discussed at length previously in this document.

Annual NO_2 NAAQS Compliance
Multiple source modeling will be performed to assess the impacts of the Project plus other sources of NO_2 in the surrounding region. Multiple source impacts will be determined by modeling Keasbey (the combustion turbine, auxiliary boiler, emergency diesel generator, and emergency diesel fire pump), Woodbridge (the combustion turbines, auxiliary boiler, emergency diesel generator, and emergency diesel fire pump), and offsite sources.

The multisource modeling analysis will be conducted using a receptor grid comprised only of those receptors that have five (5) year maximum modeled annual NO_2 impacts above the SIL (i.e., SIA of 266 meters from the Project location). The maximum modeled multiple source impacts for NO_2 will be summarized in a table, showing that the modeled concentration from all sources combined, plus ambient background, is below the annual NO_2 NAAQS of 100 $\mu g/m^3$.

PSD Class II Increment Compliance Modeling
Similar to the NAAQS modeling, the initial step is to evaluate all PSD increment consuming sources with the KEC/WEC sources to determine compliance with the increments. Background concentrations are not included in the cumulative PSD increment modeling. Compliance is demonstrated if the cumulative concentrations for each PSD pollutant and averaging period achieve the PSD increment. In the event an exceedance is determined, those receptors will be reevaluated using MAXDCONT (as discussed previously), to determine the source contributions and if KEC/WEC significantly contributes to the PSD increment exceedance.[5]

24-Hour PM-2.5 PSD Class II Increment Compliance
The U.S. EPA redesignated the area around the Keasbey Energy Center as attainment on September 4, 2013. The major source baseline date is October 20, 2010 and the minor source baseline date is February 1, 2016. The emission inventory for the PM-2.5 increment modeling will include all major sources permitted as of the major source baseline date. The recently built, operational, and immediately adjacent Woodbridge Energy Center is the single source that will be included with the Keasbey Energy Center in the 24-hour PM-2.5 increment modeling analysis.

The 24-hour PM-2.5 multisource increment modeling analysis will be conducted for all receptors located within the SIA (i.e., 2,600 meters from the Project location). The highest second-highest modeled 24-hour PM-2.5 concentration will be compared in a table to the 24-

[5] Sierra Club v. E.P.A. 705 F.3d, decided January 22, 2013. The available increment is the lesser of the PSD increment or the NAAQS minus the background concentration. The project cannot contribute more than the available increment.

hour PM-2.5 PSD Class II increment of 9.0 μg/m^3, demonstrating compliance with the short-term fine particulate PSD Class II increment.

Annual PM-2.5 PSD Class II Increment Compliance

The U.S. EPA redesignated the area around the Keasbey Energy Center as attainment on September 4, 2013. The major source baseline date is October 20, 2010 and the minor source baseline date is February 1, 2016. The emission inventory for the PM-2.5 increment modeling will include all major sources permitted as of the major source baseline date. The recently built, operational, and immediately adjacent Woodbridge Energy Center will be included with the Keasbey Energy Center in the annual PM-2.5 increment modeling analysis.

The annual PM-2.5 multisource increment modeling analysis will be conducted for all receptors located within the SIA (i.e., 800 meters from the Project location). The maximum modeled annual PM-2.5 concentration will be compared in a table to the annual PM-2.5 PSD Class II increment of 4.0 μg/m^3, demonstrating compliance with the long-term fine particulate PSD Class II increment.

24-Hour PM-10 PSD Class II Increment Compliance

The major source baseline date for PM-10 is November 15, 1978. The emission inventory for the PM-10 increment modeling includes all the sources included in the PM-10 NAAQS modeling analysis.

The 24-hour PM-10 multisource increment modeling analysis will be conducted for all receptors located within the SIA (i.e., 897 meters from the Project location). The highest second-highest modeled 24-hour PM-10 concentration will be compared in a table to the 24-hour PM-10 PSD Class II increment of 30.0 μg/m^3, demonstrating compliance with the short-term PM-10 PSD Class II increment.

Annual NO_2 PSD Class II Increment Compliance

The major source baseline date for NO_2 is February 8, 1988. The emission inventory for the NO_2 increment modeling includes all the sources included in the NO_2 NAAQS modeling analysis.

The annual NO_2 multisource increment modeling analysis will be conducted for all receptors located within the SIA (i.e., 266 meters from the Project location). The maximum modeled annual NO_2 concentration will be compared in a table to the annual NO_2 PSD Class II increment of 25.0 μg/m^3, demonstrating compliance with the long-term NO_2 PSD Class II increment.

In the event the modeling shows exceedances of the NO_2 increment, the NO_2 source inventory for PSD modeling will include only those post-baseline sources.

Resolution of a Significant Contribution to a Modeled Exceedance

The Applicant understands that if multisource modeling predicts an exceedance of any NAAQS where the Woodbridge/Keasbey Facilities are predicted to have a significant impact, the permit process cannot move forward until the modeled exceedance is resolved, or the Woodbridge/Keasbey operating scenarios are revised so that the facility does not significantly cause or contribute to the modeled exceedance at that time and location.

In the event that the multisource modeling shows that the proposed KEC/WEC modeled concentrations would significantly contribute to a modeled NAAQS or PSD increment exceedance, additional refined modeling will be employed to obviate these contributions. Such refined modeling may include any or all of the following techniques:

- Removal of receptors that occur on the offending source property. These receptors will be remodeled with all other off-property cumulative sources to demonstrate compliance with the NAAQS or PSD increments;
- Use of actual emissions rather than permitted emissions. Appendix W allows for the use of actual emissions representative of the last 2 years of normal source operation for this analysis. If actual emissions are modeled, they must first be verified and agreed upon by the review agencies.
- Use of a more appropriate background monitor, rather than the conservative regional maximum monitored concentrations, to represent the background concentration used to determine compliance with the NAAQS;
- Use of a more appropriate NO_2/NO_x ISR value for the specific combustion source contributing to the exceedance (for NO_2 1-hour concentrations only). Case-by-case NO_2/NO_x ISR values will be reviewed and agreed upon by the review agencies prior to any subsequent refined modeling.
- For PSD Increment, assess only post-baseline sources.

6.0 References

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Air Quality Modeling Protocol, February 18, 2021 conditionally approved by NJDEP on April 19, 2021.

Table 6: Initial NO_2 Major Source List

Map #	PI Name	UTM E (meters)	UTM N (meters)	Distance meters (from KEC)	Dir degrees N=0 (from KEC)
1	LANXESS CORPORATION	557688	4486018	934	11
2	BAYSHORE RECYCLING CORP	558539	4485077	1024	91
3	BUCKEYE RARITAN BAY TERMINAL	560157	4484902	2650	94
4	MIDDLESEX CNTY UTILITIES AUTH	558580	4482291	3004	159
5	MIDDLESEX CNTY UTILITIES AUTHORITY	558587	4482242	3053	159
6	CMC STEEL NEW JERSEY	557640	4481079	4023	178
7	SAYREVILLE GENERATING STATION	554874	4480835	5016	212
8	BUCKEYE PERTH AMBOY TERMINAL LLC	562127	4487888	5389	59
9	KINDER MORGAN LIQUIDS TERMINALS	562675	4486732	5412	72
10	EFS PARLIN HOLDINGS LLC	557016	4479104	6017	185
11	SEWAREN TERMINAL	562797	4488203	6126	60
12	RED OAK POWER LLC	555223	4477763	7687	197
13	PSEG FOSSIL LLC SEWAREN GENERATING STATION	563745	4489772	7787	53
15	CINNAMON BAY LLC & EDGEBORO DISPOSAL INC	551403	4479478	8305	227
17	NORTH JERSEY ENERGY ASSOC SAYREVILLE FACILITY	555580	4476719	8602	193
18	NJDOC EAST JERSEY STATE PRISON	561953	4492917	8989	30
19	RUTGERS UNIVERSITY	548211	4485279	9306	271
20	NJ RUTGERS UNIV COOK/DOUGLAS CAMPUS	548005	4485104	9510	270
21	COVANTA UNION	562062	4494757	10674	25
22	RUTGERS COLLEGE AVENUE CAMPUS	546878	4483202	10805	260
23	RAHWAY VALLEY SEWERAGE AUTH	562726	4494625	10857	29
24	DIVISION OF BRISTOL-MYERS SQUIBB COMPANY	547384	4480150	11276	244
25	LINDEN COMPRESSOR STATION	563223	4495199	11601	29
101	SAINT PETER'S UNIVERSITY HOSPITAL	545788	4483532	11850	262
26	KINDER MORGAN LIQUID TERMINALS LLC	566584	4493030	12047	49
27	MERCK SHARP & DOHME CORP - RAHWAY NJ	562135	4496298	12114	22
29	PSEG FOSSIL LLC LINDEN GEN ST & PSE&G SNG PLT	567076	4497098	15341	39
30	COGEN TECH LINDEN VENTURE LP	566370	4498211	15822	34
32	PHILLIPS 66 COMPANY	566024	4499091	16376	31
49	JOINT MEETING OF ESSEX & UNION CNTYS	567492	4499139	17223	35
33	COVALENCE SPECIALTY ADHESIVES LLC	540388	4490331	17908	287
34	EF KENILWORTH LLC	561244	4503176	18456	12
35	MERCK SHARP & DOHME CORP	561384	4503225	18534	12
36	KEAN UNIVERSITY	564611	4503636	19848	21
38	NEW JERSEY AMERICAN WATER CO	537310	4492146	21399	289
39	ANHEUSER-BUSCH INC	568267	4504872	22507	29
40	SUMMIT WEST CELGENE LLC	552693	4508816	24202	349
102	IMTT BAYONNE LLC	575922	4501207	24400	49

Table 6: Initial NO_2 Major Source List (continued)

Map #	PI Name	UTM E (meters)	UTM N (meters)	Distance meters (from KEC)	Dir degrees N=0 (from KEC)
42	BAYONNE PLANT HOLDING LLC	576778	4500642	24751	51
41	BAYONNE ENERGY CTR	576778	4500642	24751	51
43	NEWARK ENERGY CENTER	573804	4506647	27011	37
44	PASSAIC VALLEY SEWERAGE COMMISSIONERS	573147	4507358	27199	35
45	RUTGERS HEALTH SCIENCES CAMPUS - NEWARK	568225	4510580	27639	23
46	NEW JERSEY INSTITUTE OF TECHNOLOGY	569355	4510318	27859	25
47	NEWARK BAY COGENERATION PARTNERSHIP L P	573483	4508033	27945	35
48	COE BRIDGEWATER LLC	531076	4497116	29041	294
50	NESTLE USA INC BEVERAGE DIVISION	562373	4455974	29528	171
51	STONY BROOK REGIONAL SEWERAGE AUTHORITY	531843	4470300	29633	240
52	COVANTA ESSEX CO	573749	4510047	29764	33
53	PSEG FOSSIL LLC ESSEX GENERATING STATION	574274	4509967	29988	34
54	NAVAL WEAPONS STATION EARLE	571679	4457829	30730	153
103	PSEG FOSSIL LLC KEARNY GENERATING STATION	576282	4510018	31100	37
56	TEXAS EASTERN TRANSMISSION CORPORATION HANOVE	548269	4516700	32925	344
57	ALGONQUIN GAS TRANSMISSION HANOVER COMP ST	548249	4516707	32937	344
58	IMCLONE SYSTEMS LLC	524869	4489510	32943	278
59	NOVARTIS PHARMACEUTICALS CORP	550949	4518109	33656	349
60	MONMOUTH ENERGY INC	575066	4456372	33665	149
61	TRUSTEES OF PRINCETON UNIVERSITY	529119	4465789	34340	236
62	MONMOUTH COUNTY RECLAMATION CENTER	575725	4455897	34415	148
63	TRANSCO - COMPRESSOR STATION 505	522833	4486901	34728	273
104	STEVENS INSTITUTE OF TECHNOLOGY	582276	4510878	35800	44
64	MONMOUTH UNIVERSITY	584690	4459367	37426	133
65	PB NUTCLIF MASTER, LLC	571064	4520616	38012	21
66	E R SQUIBB & SONS LLC	524812	4463847	39003	237
67	LNG PLANT STATION 240	579126	4517907	39285	33
68	MONTCLAIR STATE UNIVERSITY	567622	4524004	40195	15
69	JERSEY SHORE MEDICAL CTR	581595	4451400	41419	144
70	HOPEWELL CAMPUS OWNER, LLC	519416	4466273	42498	244
71	BERGEN CNTY UTIL AUTH WTP	581654	4520750	43054	34
72	PSEG BERGEN GENERATING STATION	582234	4521402	43919	34
73	CROWN ROLL LEAF INC	571564	4527688	44845	18
74	ST JOSEPH'S HOSPITAL AND MEDICAL CTR	570233	4528242	44977	16
75	MARCAL MANUFACTURING LLC	573305	4528333	46026	20
76	ELMWOOD PARK POWER LLC	573252	4528565	46226	20
77	HACKENSACK UNIVERSITY MEDICAL CENTER	579533	4526316	46728	28
78	COLLEGE OF NEW JERSEY	518897	4457561	47431	235
79	EXXONMOBIL RESEARCH AND ENGINEERING CO	511449	4498998	48117	287

Table 6: Initial NO_2 Major Source List (continued)

Map #	PI Name	UTM E (meters)	UTM N (meters)	Distance meters (from KEC)	Dir degrees N=0 (from KEC)
81	VICINITY ENERGY TRENTON LP	520040	4451816	50122	228
82	US ARMY IMCOM PICATINNY ARSENAL	534808	4529841	50174	333
83	MONDELEZ GLOBAL LLC	572946	4533380	50686	18
85	TEXAS EASTERN TRANSMISSION LP - LAMBERTVILLE	507769	4472303	51366	256
87	EDNA MAHAN CORRECTIONAL FACILITY	506539	4497389	52436	284
93	GILBERT GENERATING STATION	486464	4490608	71264	274
95	NRG Arthur Kill (SI)	567758	4493677	13360	50
96	Fresh Kills Landfill Flare(s)(SI)	568092	4491308	12264	60
98	Pouch Terminal -LM6000 (SI)	578818	4496820	24314	61

Table 7: Sources Removed by Step 1

Map #	PI Name	UTM E (meters)	UTM N (meters)	Distance meters (from KEC)	Dir degrees N=0 (from KEC)
79	EXXONMOBIL RESEARCH AND ENGINEERING CO	511449	4498998	48,117	287
81	VICINITY ENERGY TRENTON LP	520040	4451816	50,122	228
82	US ARMY IMCOM PICATINNY ARSENAL	534808	4529841	50,174	333
83	MONDELEZ GLOBAL LLC	572946	4533380	50,686	18
85	TEXAS EASTERN TRANSMISSION LP - LAMBERTVILLE	507769	4472303	51,366	256
87	HUNTERDON COGENERATION LP	506539	4497389	52,436	284
93	GILBERT GENERATING STATION	486464	4490608	71,264	274

Table 8: Nearby Sources (within 14 kilometers)

Map #	PI Name	UTM E (meters)	UTM N (meters)	Distance meters (from KEC)	Dir degrees N=0 (from KEC)
1	LANXESS CORPORATION	557688	4486018	934	11
2	BAYSHORE RECYCLING CORP	558539	4485077	1024	91
3	BUCKEYE RARITAN BAY TERMINAL	560157	4484902	2650	94
4	MIDDLESEX CNTY UTILITIES AUTH	558580	4482291	3004	159
5	MIDDLESEX CNTY UTILITIES AUTHORITY	558587	4482242	3053	159
6	CMC STEEL NEW JERSEY	557640	4481079	4023	178
7	SAYREVILLE GENERATING STATION	554874	4480835	5016	212
8	BUCKEYE PERTH AMBOY TERMINAL LLC	562127	4487888	5389	59
9	KINDER MORGAN LIQUIDS TERMINALS	562675	4486732	5412	72
10	EFS PARLIN HOLDINGS LLC	557016	4479104	6017	185
11	SEWAREN TERMINAL	562797	4488203	6126	60
12	RED OAK POWER LLC	555223	4477763	7687	197
13	PSEG FOSSIL LLC SEWAREN GENERATING STATION	563745	4489772	7787	53
15	CINNAMON BAY LLC & EDGEBORO DISPOSAL INC	551403	4479478	8305	227
17	NORTH JERSEY ENERGY ASSOC SAYREVILLE FACILITY	555580	4476719	8602	193
18	NJDOC EAST JERSEY STATE PRISON	561953	4492917	8989	30
19	RUTGERS UNIVERSITY	548211	4485279	9306	271
20	NJ RUTGERS UNIV COOK/DOUGLAS CAMPUS	548005	4485104	9510	270
21	COVANTA UNION	562062	4494757	10674	25
22	RUTGERS COLLEGE AVENUE CAMPUS	546878	4483202	10805	260
23	RAHWAY VALLEY SEWERAGE AUTH	562726	4494625	10857	29
24	DIVISION OF BRISTOL-MYERS SQUIBB COMPANY	547384	4480150	11276	244
25	LINDEN COMPRESSOR STATION	563223	4495199	11601	29
101	SAINT PETER'S UNIVERSITY HOSPITAL	545788	4483532	11850	262
26	KINDER MORGAN LIQUID TERMINALS LLC	566584	4493030	12047	49
27	MERCK SHARP & DOHME CORP - RAHWAY NJ	562135	4496298	12114	22
95	NRG Arthur Kill(SI)	567758	4493677	13,360	50
96	Fresh Kills Landfill Flare(s)(SI)	568092	4491308	12,264	60

Note: These sources are proposed for inclusion in the NO2 inventory as “nearby” unless screened out by AERSCREEN insignificant concentrations.

Table 9: AERSCREEN Insignificant Sources- Removed by Step 2

Map #	PI Name	Distance to KEC (meters)	XOQ (Max)	Facility NOx Emission Rate (g/s)	Conc. (Max)
2	**BAYSHORE RECYCLING CORP**	1,024	5.856	1.2	5.6
6	**CMC STEEL NEW JERSEY**	4,023	0.972	6.21	4.8
10	EFS PARLIN HOLDINGS LLC	6,017	1.13	7.51	6.8
13	**PSEG FOSSIL LLC SEWAREN GENERATING STATION**	7,787	0.921	3.87	2.9
22	RUTGERS COLLEGE AVENUE CAMPUS	10,805	3.357	0.91	2.4
27	MERCK SHARP & DOHME CORP - RAHWAY NJ	12,114	1.03	1.66	1.4
41	BAYONNE ENERGY CENTER	24,751	1.4	5.59	6.3
43	NEWARK ENERGY CENTER	27,011	1.08	4.23	3.7
47	NEWARK BAY COGENERATION PARTNERSHIP L P	27,945	1.309	4.84	5.1
104	STEVENS INSTITUTE OF TECHNOLOGY	35,800	18.06	0.27	3.9
64	MONMOUTH UNIVERSITY	37,426	55.53	0.11	5.0
65	PB NUTCLIF MASTER, LLC	38,012	6.58	0.95	5.0
77	HACKENSACK UNIVERSITY MEDICAL CENTER	46,728	10.53	0.83	7.0

Note: **Sewaren, Bayshore Recycling,** and **CMC Steel New Jersey** had insignificant AERSCREEN concentrations but are subsequently proposed to be retained in the final NO_2 modeling inventory as being "nearby" sources.

Table 10A: Nitrogen Dioxide Background Concentrations (ppm)

Monitor	Daily Maximum	Annual 98th%-ile	98th%-ile 3-year Avg.	Maximum (Running 12-Month)	Calendar Year
Bayonne (2017) (#3)	0.077	0.056	0.057	0.016	0.015
Bayonne (2018) (#3)	0.084	0.056	0.057	0.016	0.016
Bayonne (2019) (#3)	0.071	0.058	0.057	0.016	0.016
Elizabeth (2017) (#6)	0.079	0.059	0.062	0.020	0.019
Elizabeth (2018) (#6)	0.084	0.061	0.060	0.020	0.019
Elizabeth (2019) (#6)	0.074	0.062	0.061	0.020	0.020
Newark (2017) (#2)	0.075	0.056	0.057	0.015	0.015
Newark (2018) (#2)	0.077	0.055	0.055	0.015	0.014
Newark (2019) (#2)	0.070	0.061	0.056	0.016	0.016
Fort Lee (2017) (#1)	0.092	0.067	0.063	0.018	0.018
Fort Lee (2018) (#1)	0.131	0.068	0.063	0.018	0.017
Fort Lee (2019) (#1)	0.110	0.066	0.067	0.017	0.017
Rutgers Univ (2017) (#4)	0.053	0.041	0.043	0.008	0.008
Rutgers Univ (2018) (#4)	0.050	0.042	0.041	0.008	0.008
Rutgers Univ (2019) (#4)	0.055	0.045	0.043	0.009	0.009

Table 10B: Nitrogen Dioxide Background Concentrations (ug/m3)

Monitor	Daily Maximum	Annual 98th%-ile	98th%-ile 3-year Avg.	Maximum (Running 12-Month)	Calendar Year
Bayonne (2017) (#3)	145	105	107	30	28
Bayonne (2018) (#3)	158	105	107	30	30
Bayonne (2019) (#3)	133	109	107	30	30
Elizabeth (2017) (#6)	149	111	117	38	36
Elizabeth (2018) (#6)	158	115	113	38	36
Elizabeth (2019) (#6)	139	117	115	38	38
Newark (2017) (#2)	141	105	107	28	28
Newark (2018) (#2)	145	103	103	28	26
Newark (2019) (#2)	132	115	105	30	30
Fort Lee (2017) (#1)	173	126	118	34	34
Fort Lee (2018) (#1)	246	128	118	34	32
Fort Lee (2019) (#1)	207	124	126	32	32
Rutgers Univ (2017) (#4)	100	77	81	15	15
Rutgers Univ (2018) (#4)	94	79	77	15	15
Rutgers Univ (2019) (#4)	103	85	81	17	17

Table 11: Sources Contributing to Background Concentrations[1]

Map #	PI Name	UTM E (meters)	UTM N (meters)	Distance meters (from KEC)	Dir degrees N=0 (from KEC)
29	PSEG FOSSIL LLC LINDEN GEN ST & PSE&G SNG PLT	567076	4497098	15,341	39
30	COGEN TECH LINDEN VENTURE LP	566370	4498211	15,822	34
32	PHILLIPS 66 COMPANY	566024	4499091	16,376	31
39	ANHEUSER-BUSCH INC	568267	4504872	22,507	29
43	NEWARK ENERGY CENTER	573804	4506647	27,011	37
44	PASSAIC VALLEY SEWERAGE COMMISSIONERS	573147	4507358	27,199	35
45	RUTGERS HEALTH SCIENCES CAMPUS - NEWARK	568225	4510580	27,639	23
46	NEW JERSEY INSTITUTE OF TECHNOLOGY	569355	4510318	27,859	25
47	NEWARK BAY COGENERATION PARTNERSHIP L P	573483	4508033	27,945	35
49	JOINT MEETING OF ESSEX & UNION CNTYS	567492	4499139	17,223	35
52	COVANTA ESSEX CO	573749	4510047	29,764	33
53	PSEG FOSSIL LLC ESSEX GENERATING STATION	574274	4509967	29,988	34
67	LNG PLANT STATION 240[2]	579126	4517907	39,285	33
72	PSEG BERGEN GENERATING STATION[2]	582234	4521402	43,919	34
102	IMTT BAYONNE LLC	575922	4501207	24,400	49
103	PSEG FOSSIL LLC KEARNY GENERATING STATION	576282	4510018	31,100	37

(1) Predominantly contributing to the monitors located at Elizabeth, Newark, and Bayonne, and removed by Step 3.
(2) Predominantly contributing to the monitors located at Fort Lee, Newark, and Bayonne, and removed by Step 3.

Table 12: Sources with Non-overlapping Significant Impact Areas – Removed by Step 4

Map #	PID	Facility	UTM E (meters)	UTM N (meters)	Distance (meters)	Vector[1] (degrees)	SIA (m)
35	41806	MERCK SHARP & DOHME CORP	561384	4503225	18,534	192	0
36	41735	KEAN UNIVERSITY	564557	4503251	19,848	201	750
41	12863	BAYONNE ENERGY CENTER	576778	4500642	24,751	231	0
42	12174	BAYONNE PLANT HOLDING	576778	4500642	24,751	231	1500
50	21146	NESTLE USA INC BEVERAGEDIVISION	562373	4455974	29,528	351	1000
54	21138	NAVAL WEAPONS STATION EARLE	571679	4457829	30,730	333	500
56	26187	TETCO HANOVER	548269	4516700	32,925	164	0
57	26239	ALGONQUIN GAS TRANSMISSION HANOVER COMP ST	548249	4516707	32,937	164	1000
58	36066	IMCLONE SYSTEMS LLC	524869	4489510	32,943	98	1000
60	21256	MONMOUTH ENERGY INC	575066	4456372	33,665	329	1000
61	61014	TRUSTEES OF PRINCETON UNIVERSITY	529119	4465789	34,340	56	2000
62	21351	MONMOUTH COUNTY RECLAMATION CENTER	575725	4455897	34,415	328	500
64	21323	MONMOUTH UNIVERSITY	584690	4459367	37,426	313	0
65	07167	PB NUTCLIF MASTER, LLC	571064	4520616	38,012	201	0
66	61052	E R SQUIBB & SONS LLC	524812	4463847	39,003	57	3500
68	07524	MONTCLAIR STATE UNIVERSITY	567622	4524004	40,195	195	1500
69	21324	JERSEY SHORE MEDICAL CTR	581595	4451400	41,419	324	1500
70	61053	BRISTOL- MYERS SQUIBB CO	519416	4466273	42,498	64	1000

Table 12: Sources with Non-overlapping Significant Impact Areas -– Removed by Step 4 (continued)

Map #	PID	Facility	UTM E (meters)	UTM N (meters)	Distance (meters)	Vector[1] (degrees)	SIA (m)
71	02620	BERGEN CNTY UTIL AUTH WTP	581654	4520750	43,054	214	2250
73	31439	CROWN ROLL LEAF INC	571564	4527688	44,845	198	750
74	31669	ST JOSEPH'S HOSPITAL AND MEDICAL CTR	570233	4528242	44,977	196	6000
75	02102	MARCAL MANUFACTURING LLC	573305	4528333	46,026	200	0
76	02624	ELMWOOD PARK POWER LLC	573252	4528565	46,226	200	2500
77	02876	HACKENSACK UNIVERSITY MEDICAL CENTER	579533	4526316	46,728	208	0
78	61008	COLLEGE OF NEW JERSEY	518897	4457561	47,431	55	750
98	NY2640200295	Pouch Terminal -LM6000	578818	4496820	24,314	241	0

(1) Degrees from KEC/WEC towards source (North=0)

Table 13: NO_2 Major Source Inventory

Map #	PID	PI Name	UTM E (meters)	UTM N (meters)	Distance (meters)	Dir degrees N=0 (from KEC)	URBAN SRC
1	18050	HATCO CORP/LANXESS SOLUTIONS US INC	557688	4486018	934	11	
2	19031	BAYSHORE RECYCLING CORP	558539	4485077	1024	91	
3	18054	BUCKEYE RARITAN BAY TERMINAL	560157	4484902	2,650	94	
4	18348	MIDDLESEX CNTY UTILITIES AUTH	558580	4482291	3,004	159	
5	18093	MIDDLESEX CNTY UTILITIES AUTHORITY	558587	4482242	3,053	159	
6	18052	CMC STEEL NEW JERSEY	557640	4481079	4,023	178	
7	17884	SAYREVILLE GENERATING STATION	554874	4480835	5,016	212	
8	18058	BUCKEYE PERTH AMBOY TERMINAL LLC	562127	4487888	5,389	59	
9	17853	KINDER MORGAN LIQUIDS TERMINALS	562675	4486732	5,412	72	URBANSRC
11	18051	SEWAREN TERMINAL	562797	4488203	6,126	60	URBANSRC
12	18195	RED OAK POWER LLC	555223	4477763	7,687	197	
13	18068	PSEG FOSSIL LLC SEWAREN GENERATING STATION	563745	4489772	7,787	53	URBANSRC
15	17901	CINNAMON BAY LLC & EDGEBORO DISPOSAL INC	551403	4479478	8,305	227	
17	18072	NJEA SAYREVILLE FACILITY	555580	4476719	8,602	193	
18	17994	NJDOC EAST JERSEY STATE PRISON	561953	4492917	8,989	30	URBANSRC
19	17958	RUTGERS UNIVERSITY, PISCATAWAY	548211	4485279	9,306	271	
20	18399	NJ RUTGERS UNIV COOK/DOUGLAS CAMPUS	548005	4485104	9,510	270	
21	41814	COVANTA UNION	562062	4494757	10,674	25	URBANSRC
23	41702	RAHWAY VALLEY SEWERAGE AUTH	562726	4494625	10,857	29	URBANSRC
24	17739	DIVISION OF BRISTOL-MYERS SQUIBB COMPANY	547384	4480150	11,276	244	
25	41722	LINDEN COMPRESSOR STATION	563223	4495199	11,601	29	URBANSRC
26	18010	KINDER MORGAN LIQUID TERMINALS LLC	566584	4493030	12,047	49	URBANSRC
33	18065	COVALENCE SPECIALTY ADHESIVES LLC	540388	4490331	17,908	287	
34	41741	EF KENILWORTH LLC	561244	4503176	18,456	192	URBANSRC
38	35862	NEW JERSEY AMERICAN WATER CO	537310	4492146	21,399	289	

Table 13: NO_2 Major Source Inventory (continued)

Map #	PID	PI Name	UTM E (meters)	UTM N (meters)	Distance (meters)	Dir degrees N=0 (from KEC)	URBAN SRC
40	41959	SUMMIT WEST CELGENE LLC	552693	4508816	24,202	169	
48	35832	CIP II/AR BRIDGEWATER HOLDINGS LLC	531076	4497116	29,041	294	
51	61036	STONY BROOK REGIONAL SEWERAGE AUTHORITY	531843	4470300	29,633	240	
59	26173	NOVARTIS PHARMACEUTICALS CORP	550949	4518109	33,656	169	
63	35742	TRANSCO - COMPRESSOR STATION 505	522833	4486901	34,728	273	
95	NY2640300014	NRG ARTHUR KILL	567758	4493677	13,360	50	URBANSRC
96	NY2649900029	Freshkills Landfill Flare(s)	568092	4491308	12,264	60	URBANSRC
101	17913	SAINT PETER'S UNIVERSITY HOSPITAL	545788	4483532	11,850	262	

Table 14: Maximum Measured Ambient Air Quality Concentrations

Pollutant	Averaging Period	Maximum Ambient Concentrations (μg/m³)			NAAQS (μg/m³)	Monitor Location	SIL (ug/m³)	NAAQS – Background (ug/m³)	Is NAAQS – Background Greater than SIL? (Y/N)
		2017	2018	2019					
NO_2	1-Hour[a] Annual	77.1 15.0	79.0 15.0	84.6 **16.9**	188 100	East Brunswick, Middlesex County, NJ, #34-023-0011	7.5 1	108 83	Y Y
PM-10	24-Hour	32	**33**	**33**	150	Jersey City, Hudson County, NJ, #34-017-1003	5	117	Y
PM-2.5[b]	24-Hour Annual	18.8 8.3	18.6 8.0	17.1 7.9	35 12	New Brunswick, Middlesex County, NJ, #34-023-0011	1.2 0.3	17 4	Y Y

[a]1-hour 3-year average 98th percentile value for NO_2 is **80.2** ug/m³.

[b]24-hour 3-year average 98th percentile value for PM-2.5 is **18.2** ug/m³; Annual 3-year average value for PM-2.5 is **8.1** ug/m³.

High second-high short term (1-, 3-, 8-, and 24-hour) and maximum annual average concentrations presented for all pollutants other than PM-2.5 and 1-hour SO_2 and NO_2.

Bold values represent the proposed background values for use in any necessary NAAQS analyses.

Monitored background concentrations obtained from the NJDEP NJ Air Quality Monitoring Report (2017-2019).

Table 15: Seasonal and Hour of Day NO_2 Background Values

Season	Hours	3-Year (2017-2019) Average Concentrations (ppb)											
Winter	1-12	47.6	47.4	48.9	46.9	48.6	49.1	73.8	62.4	57.0	58.8	49.9	50.1
Winter	13-24	48.2	47.9	45.8	43.9	45.3	47.7	47.8	49.2	49.2	52.7	48.3	47.3
Spring	1-12	45.8	49.6	49.4	50.0	53.6	56.3	58.2	58.4	53.6	49.4	46.0	39.1
Spring	13-24	39.7	38.3	38.8	39.1	40.1	42.6	43.5	44.0	47.1	46.1	47.6	45.1
Summer	1-12	34.6	35.3	33.7	35.5	38.0	40.2	41.8	38.8	38.4	39.7	36.8	34.8
Summer	13-24	33.1	37.9	37.7	34.2	35.4	36.9	35.3	35.3	38.0	38.3	38.4	35.1
Fall	1-12	39.8	39.3	39.7	40.1	41.9	44.0	44.9	46.7	48.1	49.6	37.2	36.7
Fall	13-24	33.8	34.2	36.3	36.2	39.7	43.2	43.6	44.8	43.0	41.8	41.1	40.2

Legend (maximum concentration from station):

Elizabeth
Newark
Bayonne
Fort Lee

No maximum values from East Brunswick station.

Note: Highest values from processing seasonal & hour of day data obtained from NJDEP ambient monitors located at Fort Lee, Newark, Bayonne, East Brunswick, and Elizabeth.

Table 16: Proposed Offsite Sources for Multisource Inventory

PI Number	PI Name	URBANSRC	County	NO_2	PM-10	PM-2.5
17739	DIVISION OF BRISTOL-MYERS SQUIBB COMPANY		Middlesex	X		
17853	KINDER MORGAN LIQUIDS TERMINALS		Middlesex	X		
17884	SAYREVILLE GENERATING STATION		Middlesex	X		
17901	CINNAMON BAY LLC & EDGEBORO DISPOSAL INC		Middlesex	X		
17913	SAINT PETER'S UNIVERSITY HOSPITAL		Middlesex	X		
17958	RUTGERS UNIVERSITY, PISCATAWAY		Middlesex	X		
17994	NJDOC EAST JERSEY STATE PRISON	URBANSRC	Middlesex	X		
18010	KINDER MORGAN LIQUID TERMINALS LLC	URBANSRC	Middlesex	X		
18050	LANXESS SOLUTIONS US INC		Middlesex	X		
18051	SEWAREN TERMINAL	URBANSRC	Middlesex	X		
18052	CMC STEEL NEW JERSEY		Middlesex	X		
18054	BUCKEYE RARITAN BAY TERMINAL		Middlesex	X		
18058	BUCKEYE PERTH AMBOY TERMINAL LLC		Middlesex	X		
18065	COVALENCE SPECIALTY ADHESIVES LLC		Middlesex	X		
18068	PSEG FOSSIL LLC SEWAREN GENERATING STATION	URBANSRC	Middlesex	X		
18072	NJEA SAYREVILLE FACILITY		Middlesex	X		
18093	MIDDLESEX CNTY UTILITIES AUTHORITY		Middlesex	X		
18195	RED OAK POWER LLC		Middlesex	X	X	X
18348	MIDDLESEX CNTY UTILITIES AUTH		Middlesex	X		
18399	NJ RUTGERS UNIV COOK/DOUGLAS CAMPUS		Middlesex	X		
19031	BAYSHORE RECYCLING CORP		Middlesex	X		
26173	NOVARTIS PHARMACEUTICALS CORP		Morris	X		
35742	TRANSCO - COMPRESSOR STATION 505		Somerset	X		
35832	CIP II/AR BRIDGEWATER HOLDINGS LLC		Somerset	X		

Table 16 – Proposed Offsite Sources for Multisource Inventory (Continued)

PI Number	PI Name	URBANSRC	County	NO_2	PM-10	PM-2.5
35862	NEW JERSEY AMERICAN WATER CO		Somerset	X		
41702	RAHWAY VALLEY SEWERAGE AUTH	URBANSRC	Union	X		
41722	LINDEN COMPRESSOR STATION	URBANSRC	Union	X		
41741	EF KENILWORTH LLC	URBANSRC	Union	X		
41814	COVANTA UNION		Union	X		
41959	SUMMIT WEST CELGENE LLC		Union	X		
61036	STONY BROOK REGIONAL SEWERAGE AUTHORITY		Mercer	X		
NY2640300014	NRG ARTHUR KILL	URBANSRC	Kings, NY	X		
NY2649900029	Freshkills Landfill Flare(s)	URBANSRC	Kings, NY	X		

Table 17: Proposed Multisource Modeling Inventory (1-hour NO2)

FACILITY			STACK													SHORT-TERM EMISSIONS	
Name	PI ##	Source Description	AERMOD ID	PT ID	UTME	UTMN	Grade	Height	Height	Diameter	Diameter	Velocity	Velocity	Temperature	Temperature	NOx	NOx
					(m)	(m)	(m)	(ft)	(m)	(ft)	(m)	(ft/s)	(m/s)	(F)	(K)	(lb/hr)	(g/s)
		Recip Engines	35742PT1	PT1-PT8	522,833	4,486,901	56.4	32.0	9.75	1.7	0.51	101.6	30.97	550	560.9	90.40	11.39
TRANSCO - COMPRESSOR STATION 505	35742	Recip Engines	35742PT10	PT10	522,833	4,486,901	56.4	19.0	5.79	1.3	0.38	21.7	6.62	450	505.4	0.39	0.049
		Engines	35862PT101	PT101	536,829	4,488,414	33.5	55.0	16.76	0.3	0.10	423.6	129.12	871	739.3	6.40	0.806
		Engines	35862PT102	PT102	536,829	4,488,414	33.5	55.0	16.76	0.3	0.10	440.8	134.35	930	772.0	11.87	1.496
NEW JERSEY AMERICAN WATER CO	35862	Engines	35862PT201	PT201-PT204	537,310	4,488,414	33.5	24.0	7.32	1.2	0.36	122.4	37.31	860	733.2	8.04	1.013
		Marine TO #1	17853PT21	PT21	563,456	4,486,066	1.0	56.0	17.07	8.0	2.44	50.4	15.36	1700	1199.8	38.10	4.801
		Boiler	17853P55	P55	563,456	4,486,066	1.0	45.0	13.72	1.0	0.30	21.2	6.47	375	463.7	0.42	0.053
		Boiler	17853PT57	PT57	563,456	4,486,066	1.0	12.0	3.66	0.8	0.25	15.1	4.59	380	466.5	0.10	0.013
		Heaters	17853PT73	PT73,PT74	563,456	4,486,066	1.0	20.0	6.10	1.0	0.30	29.4	8.96	450	505.4	0.48	0.060
		Heaters	17853PT75	PT75,PT76	563,456	4,486,066	1.0	24.0	7.32	2.0	0.61	5.3	1.62	300	422.0	1.20	0.151
KINDER MORGAN LIQUIDS TERMINALS	17853	Marine TO #2	17853PT3013	PT3013	563,456	4,486,066	1.0	50.0	15.24	9.0	2.74	39.8	12.14	1700	1199.8	38.10	4.801
		Boilers	18050PT8243	PT8243,PT82060	557,688	4,486,018	13.0	45.0	13.72	4.0	1.22	39.8	12.13	350	449.8	11.72	1.477
		Heater	18050PT8167	PT8167	557,688	4,486,018	13.0	35.0	10.67	1.5	0.46	56.6	17.25	700	644.3	0.74	0.093
		Heater	18050PT8168	PT8168	557,688	4,486,018	13.0	35.0	10.67	2.5	0.76	20.4	6.21	700	644.3	1.30	0.164
		Heater	18050PT8259	PT8259	557,688	4,486,018	13.0	40.0	12.19	2.3	0.71	23.5	7.15	745	669.3	1.10	0.139
		Heater	18050PT8275	PT8275	557,688	4,486,018	13.0	40.0	12.19	2.3	0.71	23.6	7.19	745	669.3	1.13	0.142
LANXESS SOLUTIONS US INC	18050	Heater	18050PT8290	PT8290	557,688	4,486,018	13.0	45.0	13.72	2.5	0.76	23.8	7.24	550	560.9	1.55	0.195
		Marine Vapor Control	18058PT1001	PT1001,PT1002	563,128	4,487,418	1.0	60.0	18.29	10.5	3.20	66.0	20.12	1575	1130.4	78.60	9.904
		Heater	18058PT1602	PT1602	563,128	4,487,418	1.0	113.0	34.44	5.0	1.52	11.5	3.49	400	477.6	2.35	0.296
BUCKEYE PERTH AMBOY TERMINAL LLC	18058	Heater	18058PT1603	PT1603	563,128	4,487,418	1.0	95.0	28.96	4.5	1.37	14.1	4.31	400	477.6	2.35	0.296
		Thermal Fluid Heater	18093PT151	PT151-PT155	558,738	4,482,383	12.2	37.0	11.28	2.5	0.76	10.9	3.31	477	520.4	4.90	0.617
		Boiler	18093PT251	PT251	558,738	4,482,383	12.2	26.0	7.92	2.2	0.66	22.1	6.75	273	406.8	0.69	0.087
MIDDLESEX CNTY UTILITIES AUTHORITY	18093	Boiler	18093PT252	PT252	558,738	4,482,383	12.2	26.0	7.92	2.2	0.66	22.1	6.75	273	406.8	0.69	0.087
		Marine Loading Flare	18054PT29	PT29	560,086	4,484,737	3.0	20.0	6.10	0.7	0.20	62.5	19.06	1000	810.9	5.18	0.653
		Boiler	18054PT30	PT30	560,086	4,484,737	3.0	38.0	11.58	2.0	0.61	65.9	20.08	503	534.8	10.30	1.298
		Boiler	18054PT31	PT31	560,086	4,484,737	3.0	30.0	9.14	2.0	0.61	49.5	15.09	503	534.8	8.97	1.130
BUCKEYE RARITAN BAY TERMINAL	18054	Boiler	18054PT32	PT32	560,086	4,484,737	3.0	30.0	9.14	2.0	0.61	40.8	12.45	503	534.8	7.59	0.956
		CT #1	18348PT1	PT1	558,042	4,482,458	3.0	60.0	18.29	5.0	1.52	65.4	19.92	437	498.2	13.80	1.739
MIDDLESEX CNTY UTILITIES AUTH	18348	CT #2	18348PT2	PT2	558,042	4,482,458	3.0	60.0	18.29	5.0	1.52	65.4	19.92	437	498.2	13.80	1.739
		Rotary kiln	19031PT3	PT3	558,608	4,484,871	1.5	150.0	45.72	5.0	1.52	35.8	10.92	350	449.8	9.52	1.200
BAYSHORE RECYCLING CORP	19031	Boiler	19031PT16	PT16	558,608	4,484,871	1.5	50.0	15.24	2.0	0.61	22.5	6.86	350	449.8	0.70	0.088
SEWAREN TERMINAL	18051	Vapor Recovery	18051PT198	PT198	563,110	4,488,145	3.0	45.0	13.72	8.0	2.44	41.4	12.63	1750	1227.6	14.02	1.767
STONY BROOK REGIONAL SEWERAGE AUTHORITY	61036	Sludge Incinerators	61036PT1	PT1, PT2	531,932	4,470,337	19.8	68.0	20.73	2.5	0.76	45.5	13.87	120	322.0	28.00	3.528
		Electric Arc Furnace	18052PT201	PT201	557,423	4,481,169	6.1	183.0	55.78	13.0	3.96	50.2	15.31	700	644.3	31.00	3.906
GERDAU AMERISTEEL SAYREVILLE	18052	Reheat Furnace	18052PT301	PT301	557,423	4,481,169	6.1	185.0	56.39	5.5	1.68	37.2	11.33	1000	810.9	17.30	2.180
		Boiler	41959PT4	PT4	552,575	4,508,750	71.6	65.0	19.81	3.9	1.19	59.1	18.00	350	449.8	4.85	0.611
		Boilers	41959PT3	PT3	552,575	4,508,750	71.6	40.0	12.19	3.5	1.07	119.7	36.49	350	449.8	15.26	1.923
SUMMIT WEST CELGENE LLC	41959	Boiler	41959PT15	PT15	552,575	4,508,750	71.6	43.0	13.11	3.4	1.04	82.2	25.05	525	547.0	1.72	0.217
PSEG FOSSIL LLC SEWAREN GENERATING STATION	18068	Combustion Turbine	18068PT102	PT102	563,929	4,490,010	4.6	313.0	95.40	23.0	7.01	71.8	21.90	165	347.0	30.70	3.868
SAYREVILLE GENERATING STATION	17884	Combustion Turbines	17884PT18	PT18	554,874	4,480,835	1.0	120.0	36.58	20.0	6.10	47.7	14.55	749	671.5	372.00	46.872
		Combustion Turbines	18195PT1	PT1	555,223	4,477,763	13.1	150.0	45.72	32.9	10.03	62.9	19.17	225	380.4	75.90	9.563
RED OAK POWER LLC	18195	Fuel Gas Heaters	18195PT7	PT7	555,223	4,477,763	13.1	30.0	9.14	1.3	0.41	29.1	8.87	559	565.9	1.92	0.242
		Engines	17901PT1	PT1	551,382	4,479,593	4.9	83.0	25.30	6.0	1.83	27.7	8.44	924	768.7	14.76	1.860
		Flare	17901PT2	PT2	551,382	4,479,593	4.9	40.0	12.19	8.7	2.64	2.1	0.64	1600	1144.3	3.60	0.454
		Flare	17901PT3	PT3	551,382	4,479,593	4.9	40.0	12.19	8.7	2.64	2.1	0.64	1600	1144.3	3.60	0.454
		Flare	17901PT5	PT5	551,382	4,479,593	4.9	18.0	5.49	0.7	0.20	210.1	64.03	1500	1088.7	2.27	0.286
CINNAMON BAY LLC & EDGEBORO DISPOSAL INC	17901	Flare	17901PT6	PT6	551,382	4,479,593	4.9	18.0	5.49	0.5	0.15	203.7	62.09	1500	1088.7	1.23	0.155
NORTH JERSEY ENERGY ASSOC SAYREVILLE FACILITY	18072	Turbines	18072PT1	PT1	555,528	4,476,719	6.4	190.0	57.91	25.0	7.62	23.1	7.04	210	372.0	258.00	32.508
NJDOC EAST JERSEY STATE PRISON	17994	Boilers	17994PT1	PT1	561,909	4,493,558	7.3	33.0	10.06	4.5	1.37	53.7	16.36	425	491.5	26.00	3.276
		Boiler	17958PT41	PT41	545,527	4,486,291	27.4	12.0	3.66	2.5	0.76	5.1	1.55	220	377.6	4.13	0.520
		Boiler	17958PT5	PT5	545,527	4,486,291	27.4	48.0	14.63	2.5	0.76	10.2	3.10	220	377.6	1.63	0.205
RUTGERS UNIVERSITY, PISCATAWAY	17958	Turbines	17958PT1	PT1	545,527	4,486,291	27.4	125.0	38.10	4.0	1.22	54.6	16.64	911	761.5	12.60	1.588
COVANTA UNION	41814	MSW Combustors	41814PT5	PT5	562,062	4,494,708	4.6	280.0	85.34	6.0	1.83	79.3	24.17	293	418.2	240.00	30.240
		Flares	41702PT501	PT501	562,832	4,494,481	6.0	37.0	11.28	0.5	0.15	89.7	27.35	775	685.9	1.68	0.212
		Boiler	41702PT801	PT80001	562,832	4,494,481	6.0	28.0	8.53	1.8	0.53	10.4	3.17	325	435.9	0.27	0.034
		Boiler	41702PT1301	PT130001	562,832	4,494,481	6.0	35.0	10.67	0.5	0.15	76.4	23.29	600	588.7	0.13	0.016
		Engines	41702PT2401	PT240001	562,832	4,494,481	6.0	100.0	30.48	2.0	0.61	62.0	18.91	454	507.6	13.16	1.658
		Heater	41702PT2501	PT250001	562,832	4,494,481	6.0	100.0	30.48	2.0	0.61	35.0	10.67	550	560.9	0.74	0.093
RAHWAY VALLEY SEWERAGE AUTH	41702	Boilers	41702PT2802	PT280002	562,832	4,494,481	6.0	26.0	7.92	1.3	0.41	15.2	4.64	340	444.3	0.58	0.073
		Turbine	17739PT4601	PT4601	546,978	4,480,632	30.5	60.0	18.29	6.7	2.03	52.7	16.05	275	408.2	4.50	0.567
		Boiler	17739PT4603	PT4603	546,978	4,480,632	30.5	60.0	18.29	4.5	1.37	35.0	10.67	328	437.6	5.71	0.719
DIVISION OF BRISTOL-MYERS SQUIBB COMPANY	17739	Boiler	17739PT4604	PT4604	546,978	4,480,632	30.5	60.0	18.29	4.5	1.37	35.0	10.67	328	437.6	5.71	0.719
LINDEN COMPRESSOR STATION	41722	Turbines	41722PT1	PT1	563,111	4,495,200	7.0	57.0	17.37	1.7	0.51	271.4	82.72	800	699.8	35.70	4.498
		Thermal Oxidizer	18010PT99	PT99	566,584	4,493,030	1.0	35.0	10.67	4.6	1.40	15.2	4.62	1500	1088.7	1.35	0.170
		Boiler	18010PT306	PT306	566,584	4,493,030	1.0	50.0	15.24	3.8	1.14	22.6	6.90	350	449.8	2.50	0.315
		Boilers	18010PT600	PT600	566,584	4,493,030	1.0	40.0	12.19	2.0	0.61	53.1	16.17	500	533.2	4.20	0.529
		Flare	18010PT307	PT307	566,584	4,493,030	1.0	50.0	15.24	10.0	3.05	424.4	129.36	1550	1116.5	21.91	2.761
KINDER MORGAN LIQUID TERMINALS LLC	18010	Flare	18010PT308	PT308	566,584	4,493,030	1.0	50.0	15.24	10.0	3.05	424.4	129.36	1550	1116.5	21.91	2.761
		Thermal Oxidizer	18065PT2	PT2	540,388	4,490,331	7.0	50.0	15.24	4.2	1.27	61.1	18.63	600	588.7	12.85	1.619
COVALENCE SPECIALTY ADHESIVES LLC	18065	Boiler	18065PT4	PT4	540,388	4,490,331	7.0	25.0	7.62	1.5	0.46	6.1	1.87	300	422.0	0.27	0.034
EF KENILWORTH LLC	41741	Turbine	41741PT2	PT2	561,244	4,503,176	26.8	85.0	25.91	8.0	2.44	53.7	16.36	278	409.8	84.20	10.609
		Boilers	35832PT1	PT1	530,922	4,497,080	43.3	60.0	18.29	3.0	0.91	35.2	10.72	420	488.7	14.16	1.784
		Cogen	35832PT17	PT17	530,922	4,497,080	43.3	60.0	18.29	3.5	1.07	156.8	47.78	987	803.7	9.09	1.145
CIP II/AR BRIDGEWATER HOLDINGS LLC	35832	Boiler	35832PT23	PT23	530,922	4,497,080	43.3	60.0	18.29	3.0	0.91	35.4	10.78	300	422.0	2.17	0.273
		Energy Recovery System	26173PT3401	PT3401	551,676	4,517,611	67.1	59.0	17.98	1.5	0.46	60.7	18.51	400	477.6	2.00	0.252
		Boiler	26173PT11101	PT11101	551,676	4,517,611	67.1	77.0	23.47	1.7	0.51	21.7	6.60	337	442.6	1.23	0.155
		Boiler	26173PT11201	PT11201	551,676	4,517,611	67.1	56.0	17.07	1.3	0.41	21.6	6.59	303	423.7	0.82	0.103
		Boiler	26173PT12101	PT12101	551,676	4,517,611	67.1	80.0	24.38	2.5	0.76	57.1	17.39	298	420.9	3.01	0.379
		Boilers	26173PT14001	PT14001	551,676	4,517,611	67.1	44.0	13.41	1.0	0.30	9.0	2.74	320	433.2	0.62	0.077
		Boiler	26173PT9801	PT9801	551,676	4,517,611	67.1	80.0	24.38	4.7	1.42	41.9	12.78	310	427.6	6.11	0.770
NOVARTIS PHARMACEUTICALS CORP	26173	Boilers	26173PT9501	PT9501	551,676	4,517,611	67.1	44.0	13.41	0.8	0.25	11.5	3.50	270	405.4	0.40	0.050
		Boiler	18399PT8	PT8	547,873	4,481,274	36.6	21.0	6.40	1.3	0.38	13.2	4.04	400	477.6	6.56	0.827
		Boiler	18399PT21	PT21	547,873	4,481,274	36.6	40.0	12.19	3.0	0.91	12.9	3.92	550	560.9	7.63	0.961
		Boiler	18399PT42	PT42	547,873	4,481,274	36.6	50.0	15.24	1.2	0.36	32.7	9.98	200	366.5	4.22	0.532
NJ RUTGERS UNIV COOK/DOUGLAS CAMPUS	18399	Boiler	18399PT50	PT50	547,873	4,481,274	36.6	85.0	25.91	3.0	0.91	13.0	3.95	300	422.0	7.01	0.883
NRG Arthur Kill	2-6403-00014	Boilers	NYNRGArthur	Boilers	567,758	4,493,677	1.6	502.0	153.01	19.3	5.89	127.0	38.71	250	394.3	1291.00	162.666
Fresh Kills Landfill	2-6499-00029	Flares	NYFreskKills	Flares	568,716	4,492,028	4.3	56.7	17.28	1.3	0.39	65.6	20.00	1832	1273.0	68.70	8.656
		Boilers	17913PT1	PT1	545,786	4,483,451	15.2	52.0	15.85	4.5	1.37	26.2	7.99	475	519.3	3.46	0.436
		Boilers	17913PT10	PT10	545,786	4,483,451	15.2	65.0	19.81	1.5	0.46	17.9	5.46	260	399.8	0.74	0.093
SAINT PETERS HOSPITAL	17913	CHP	17913PT12	PT12	545,786	4,483,451	15.2	35.0	10.67	3.0	0.91	22.5	6.84	758	676.5	0.85	0.107

Table 17: Proposed Multisource Modeling Inventory (PM-10/PM-2.5)

FACILITY			STACK													SHORT-TERM EMISSIONS	
Name	PI ##	Source Description	AERMOD ID	PT ID	UTME	UTMN	Grade	Height	Height	Diameter	Diameter	Velocity	Velocity	Temperature	Temperature	lb/hr	g/s
RED OAK POWER LLC	18195	Combustion Turbines	18195PT1	PT1	555,223	4,477,763	13.1	150.0	45.72	32.9	10.03	62.9	19.17	225	380.4	88.29	11.120
		Fuel Gas Heaters	18195PT7	PT7	555,223	4,477,763	13.1	30.0	9.14	1.3	0.41	29.1	8.87	559	565.9	0.12	0.020

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Table 18: Keasbey Energy Center Combustion Turbine/HRSG Modeled Source Parameters

Operating Case	Fuel	Ambient Temperature (F)	Operating Load (%)	Duct Firing (On/Off)	Evaporative Cooler Operation (On/Off)	Modeling Stack Parameters		
						Exhaust Temperature (K)	Exhaust Velocity (m/s)[a]	Exhaust Flow (acfm)
Case11	Gas	105	100	On	Off	337.04	19.20	1,436,816

[a]Based on a stack diameter of 22 feet.
UTM coordinates of proposed 160 foot above grade combustion turbine/HRSG stack are 557,515 meters Easting, 4,485,100 meters Northing, NAD83, Zone 18 at a base elevation of 22.5 feet above mean sea level.

Table 19: Keasbey Energy Center Combustion Turbine/HRSG Emission Rates

Operating Case	Modeled Emission Rate (g/s)	
	NO_x	PM-10/PM-2.5
Case11	3.80	2.98

Table 20: Woodbridge Energy Center Combustion Turbine/HRSG Source Parameters

Operating Case	Fuel	Ambient Temperature (F)	Operating Load (%)	Duct Firing (On/Off)	Evaporative Cooler Operation (On/Off)	Modeling Stack Parameters		
						Exhaust Temperature (K)	Exhaust Velocity (m/s)[a]	Exhaust Flow (acfm)
Case7	Gas	59	100	On	Off	351.4	18.03	1,115,284
Case9	Gas	59	50	Off	Off	345.5	11.85	732,549

[a]Based on a stack diameter of 20 feet.
UTM coordinates of two (2) 145 foot combustion turbine stacks are 557,683 meters Easting, 4,485,153 meters Northing, and 557,722 meters Easting, 4,485,161 meters Northing, NAD83, Zone 18 at a base elevation of 19.5 feet above mean sea level.

Table 21: Woodbridge Energy Center Combustion Turbine/HRSG Emission Rates

Operating Case	Modeled Emission Rate (g/s) – per turbine	
	NO_x	PM-10/PM-2.5
Case7	2.31	2.41
Case9	1.22	1.36

Table 22: Keasbey Energy Center Combustion Turbine Start-up and Shutdown Emission Rates and Stack Parameters

Combustion Turbine Startup/Shutdown Parameters – Rapid Response (Natural Gas Fired)							
Event	**Elapsed Time (hr)**	**Stack NO_x (Max lb/hr)**	**Stack PM-10 (Max lb/hr)**	**Stack PM-2.5 (Max lb/hr)[a]**	**Stack Exhaust Flow (acfm)**	**Stack Exhaust Velocity (m/s)**	**Stack Exhaust Temperature (Degrees F)**
Startup	1	250.7	10.4	10.4	671,086	8.97	160
Shutdown	0.50	17.5	5.3	5.3	671,086	8.97	160

	Type of Startup or Shutdown Event	
	Startup	Shutdown
Duration of Turbine at 0% load prior to Start-up (hours)	8	-
Maximum Duration of Start-up or Shut-down Event (hours)	1	0.5
Maximum Number per Year	262	262

Table 23: Keasbey Energy Center Combustion Turbine Start-up and Shutdown Modeling Methodology

Transient Condition	Normal Operation Worst Case	Duration	Averaging Period	NO_x		PM-10		PM-2.5	
		Hours		lb/hr	g/s	lb/hr	g/s	lb/hr	g/s
NG Startup	-	1	1-hour	251	31.6	-	-	-	-
NG Shutdown	-	0.5	1-hour	17.5	2.21	-	-	-	-
	Case11sd	0.5	1-hour	15.1	1.90	-	-	-	-
NG Startup	-	1	24-hour	-	-	0.43	0.06	0.43	0.06
	Case11c	23	24-hour	-	-	22.7	2.86	22.7	2.86
NG Shutdown	-	0.5	24-hour	-	-	0.22	0.03	0.22	0.03
	Case11sd	23.5	24-hour	-	-	23.2	2.92	23.2	2.92

Table 24: Woodbridge Energy Center Combustion Turbine Start-up and Shutdown Emission Rates and Stack Parameters

GE 7FA.05 Combustion Turbine Start-up/Shutdown Parameters					
Event	**Elapsed Time (hr)**	**Stack NOx (lb/hr)**	**Average Stack Exhaust Flow (acfm)**	**Average Stack Exhaust Velocity (m/s)**	**Average Stack Exhaust Temperature (Degrees F)**
Startup – Per Turbine	3.4	112	550,000	8.89	160
Shutdown – Per Turbine	0.5	68.5	550,000	8.89	160

Table 25: Woodbridge Energy Center Combustion Turbine Start-up and Shutdown Modeling Methodology

Transient Condition	Normal operation worst case	Duration	Averaging Period	NO_x	
		Hours		lb/hr	g/s
NG Startup	-	3.4	1-hour	112	14.1
NG Shutdown	-	0.5	1-hour	68.5	8.63
	Case7sd	0.5	1-hour	9.2	1.16

Table 26: Keasbey and Woodbridge Energy Centers – Annual Emission Rates

	KEC Emissions[a]		WEC Emissions[b]	
Air Contaminant	**TPY**	**g/s**	**TPY**	**g/s**
NO_2	140.8	4.05	145.9	2.1
PM-10	96.3	2.77	92.0	1.32
PM-2.5	96.3	2.77	92.0	1.32

(a) Emissions for the single combustion turbine
(b) TPY Emissions are total, g/s emissions per combustion turbine

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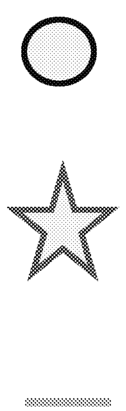


Keasbey Energy Center Location

Maximum Modeled Concentration (9.6 ug/m^3)

Concentration > 5 ug/m^3

TRC
1099 Wall St. West, Suite 250B
Lyndhurst, NJ 07071
201-933-5541

24-HOUR PM-10 MAXIMUM MODELED CONCENTRATION ISOPLETHS – NORMAL OPERATIONS

CPV KEASBEY, LLC
WOODBRIDGE, NEW JERSEY

FIGURE 1	**SEPTEMBER 2021**

Keasbey Energy Center Location

Maximum Modeled Concentration (7.4 ug/m^3)

Concentration > 1.2 ug/m^3

TRC
1099 Wall St. West, Suite 250B
Lyndhurst, NJ 07071
201-933-5541

24-HOUR PM-2.5 MAXIMUM MODELED CONCENTRATION ISOPLETHS – NORMAL OPERATIONS

CPV KEASBEY, LLC
WOODBRIDGE, NEW JERSEY

FIGURE 2	**SEPTEMBER 2021**

Keasbey Energy Center Location

Maximum Modeled Concentration (23.1 ug/m^3)

Concentration > 7.5 ug/m^3

TRC
1099 Wall St. West, Suite 250B
Lyndhurst, NJ 07071
201-933-5541

1-HOUR NO2 MAXIMUM MODELED CONCENTRATION ISOPLETHS – NORMAL OPERATIONS

CPV KEASBEY, LLC
WOODBRIDGE, NEW JERSEY

FIGURE 3	SEPTEMBER 2021

Keasbey Energy Center Location

Maximum Modeled Concentration (1.3 ug/m^3)

Concentration > 1 ug/m^3

TRC
1099 Wall St. West, Suite 250B
Lyndhurst, NJ 07071
201-933-5541

ANNUAL NO2 MAXIMUM MODELED CONCENTRATION ISOPLETHS – NORMAL OPERATIONS

CPV KEASBEY, LLC
WOODBRIDGE, NEW JERSEY

FIGURE 4	**SEPTEMBER 2021**

Keasbey Energy Center Location

Maximum Modeled Concentration (0.4 ug/m^3)

Concentration > 0.3 ug/m^3

TRC
1099 Wall St. West, Suite 250B
Lyndhurst, NJ 07071
201-933-5541

ANNUAL PM-2.5 MAXIMUM MODELED CONCENTRATION ISOPLETHS – NORMAL OPERATIONS

CPV KEASBEY, LLC
WOODBRIDGE, NEW JERSEY

FIGURE 5	SEPTEMBER 2021

Keasbey Energy Center Location

Maximum Modeled Concentration (9.6 ug/m³)

Concentration > 5 ug/m³

TRC
1099 Wall St. West, Suite 250B
Lyndhurst, NJ 07071
201-933-5541

24-HOUR PM-10 MAXIMUM MODELED CONCENTRATION ISOPLETHS – INCLUDES SUSD OPERATIONS

CPV KEASBEY, LLC
WOODBRIDGE, NEW JERSEY

FIGURE 6	**SEPTEMBER 2021**

Keasbey Energy Center Location

Maximum Modeled Concentration (7.4 ug/m^3)

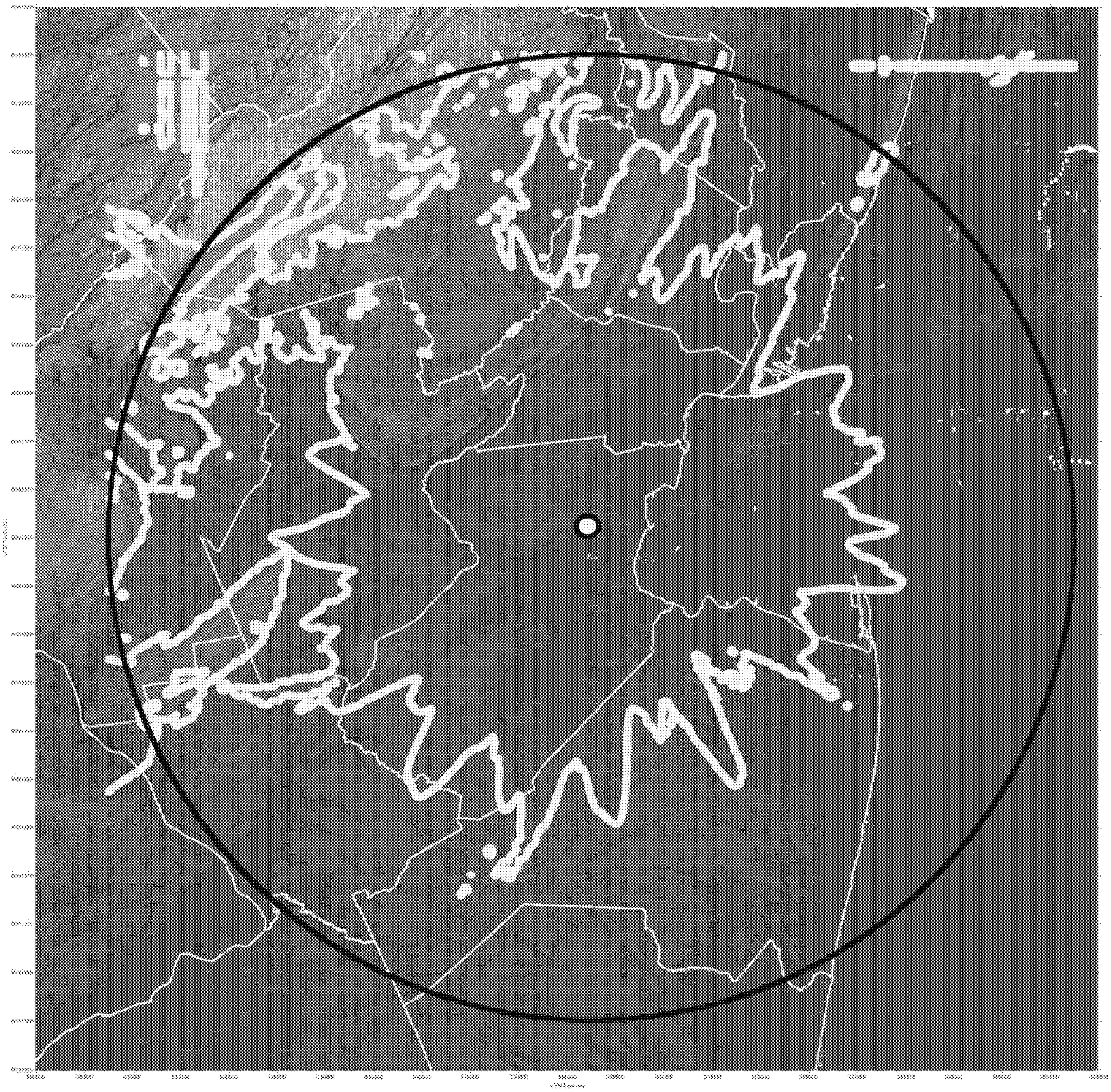
Concentration > 1.2 ug/m^3

TRC
1099 Wall St. West, Suite 250B
Lyndhurst, NJ 07071
201-933-5541

24-HOUR PM-10 MAXIMUM MODELED CONCENTRATION ISOPLETHS – INCLUDES SUSD OPERATIONS

CPV KEASBEY, LLC
WOODBRIDGE, NEW JERSEY

FIGURE 7	**SEPTEMBER 2021**



Keasbey Energy Center Location

Maximum Modeled Concentration (74.4 ug/m³)

Concentration > 7.5 ug/m³

TRC
1099 Wall St. West, Suite 250B
Lyndhurst, NJ 07071
201-933-5541

1-HOUR NO2 MAXIMUM MODELED CONCENTRATION ISOPLETHS – INCLUDES SUSD OPERATIONS

CPV KEASBEY, LLC
WOODBRIDGE, NEW JERSEY

FIGURE 8 | **SEPTEMBER 2021**

Keasbey Energy Center Location

Maximum Modeled Concentration ($1.3\ ug/m^3$)

Concentration > $1\ ug/m^3$

TRC 1099 Wall St. West, Suite 250B
Lyndhurst, NJ 07071
201-933-5541

ANNUAL NO2 MAXIMUM MODELED CONCENTRATION ISOPLETHS – INCLUDES SUSD OPERATIONS

CPV KEASBEY, LLC
WOODBRIDGE, NEW JERSEY

FIGURE 9	**SEPTEMBER 2021**

Keasbey Energy Center Location

Maximum Modeled Concentration (0.4 ug/m^3)

Concentration > 0.3 ug/m^3

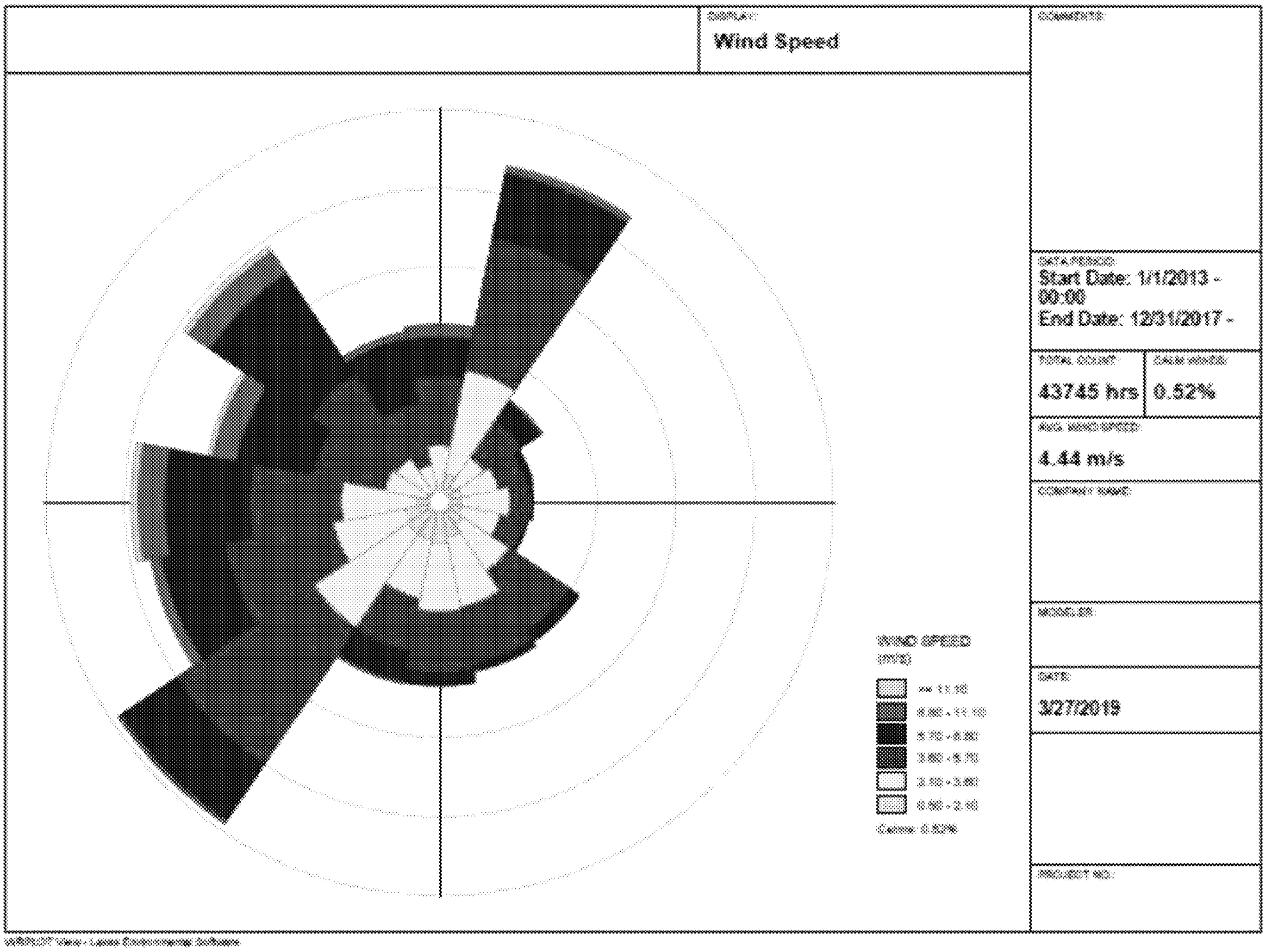
TRC
1099 Wall St. West, Suite 250B
Lyndhurst, NJ 07071
201-933-5541

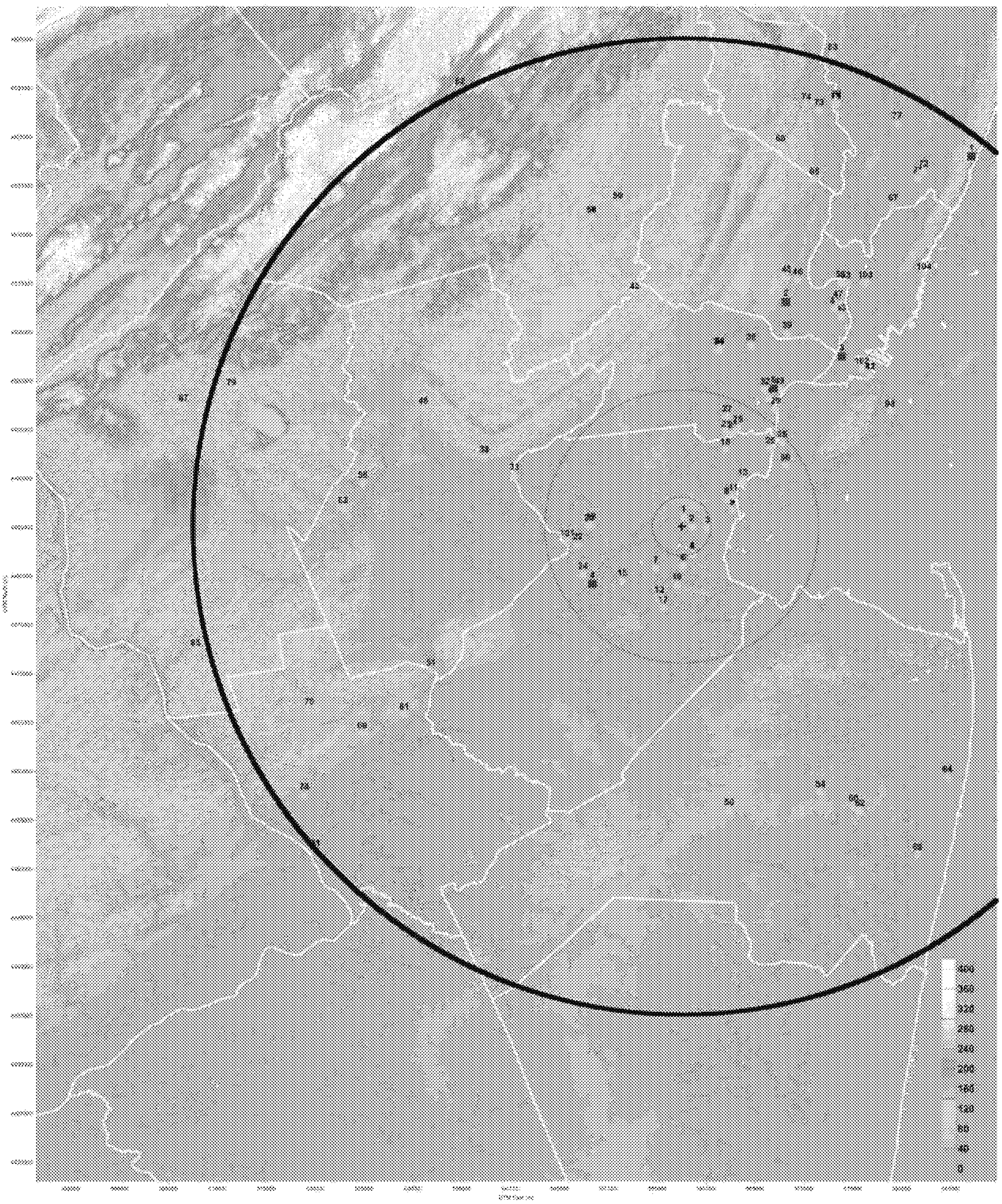
ANNUAL PM-2.5 MAXIMUM MODELED CONCENTRATION ISOPLETHS – INCLUDES SUSD OPERATIONS

CPV KEASBEY, LLC
WOODBRIDGE, NEW JERSEY

FIGURE 10	SEPTEMBER 2021

Figure 11: Newark Airport Windrose





Source in NJDEP Inventory

Ambient Background Monitor

Location of Keasbey Energy Center

Basemap: USGS National Elevation Dataset (NED) (Meters)

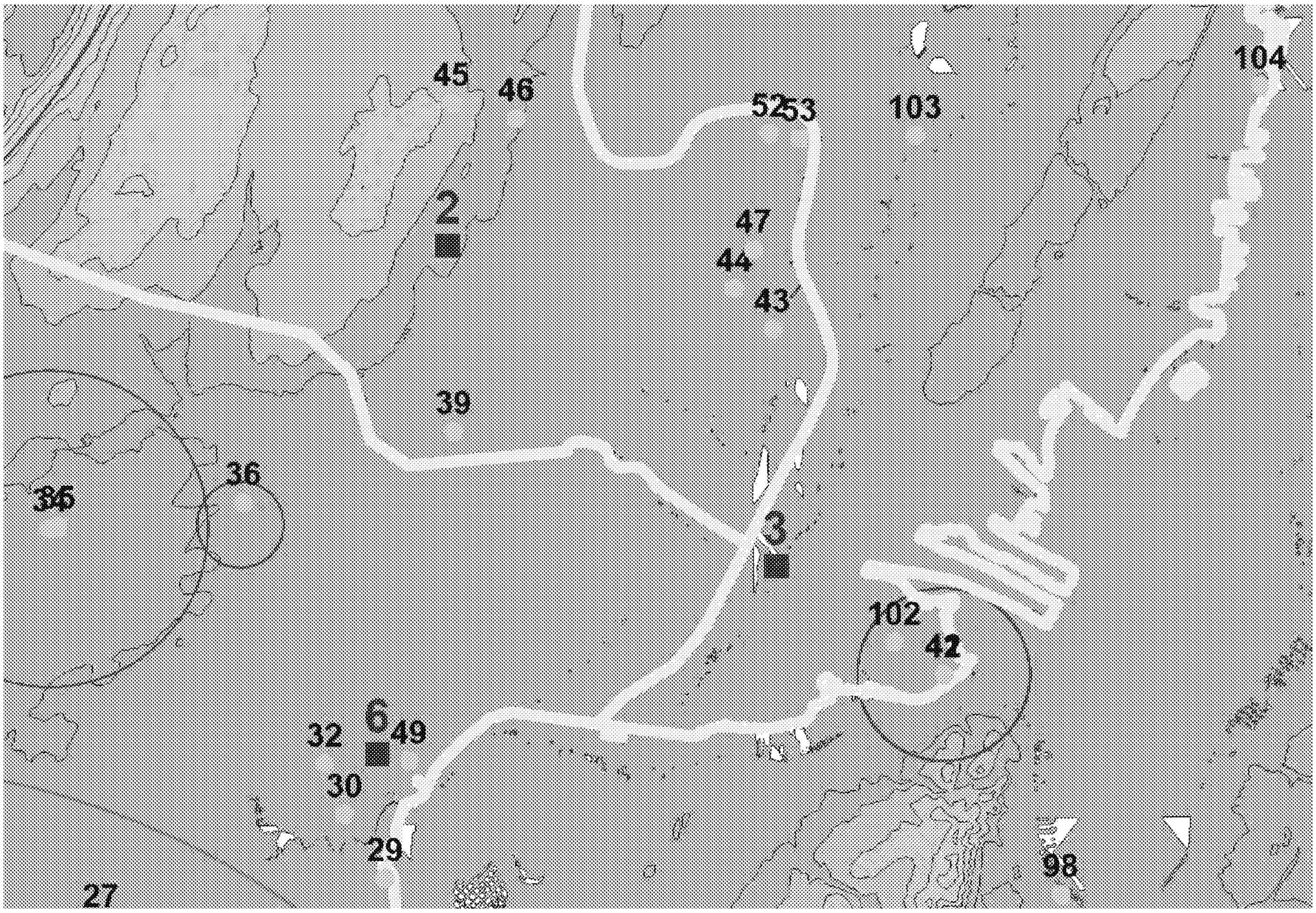
TRC 1099 Wall St. West, Suite 250B
Lyndhurst, NJ 07071
201-933-5541

INITIAL NO2 SOURCE LOCATIONS

CPV KEASBEY, LLC
WOODBRIDGE, NEW JERSEY

FIGURE 12	**SEPTEMBER 2021**

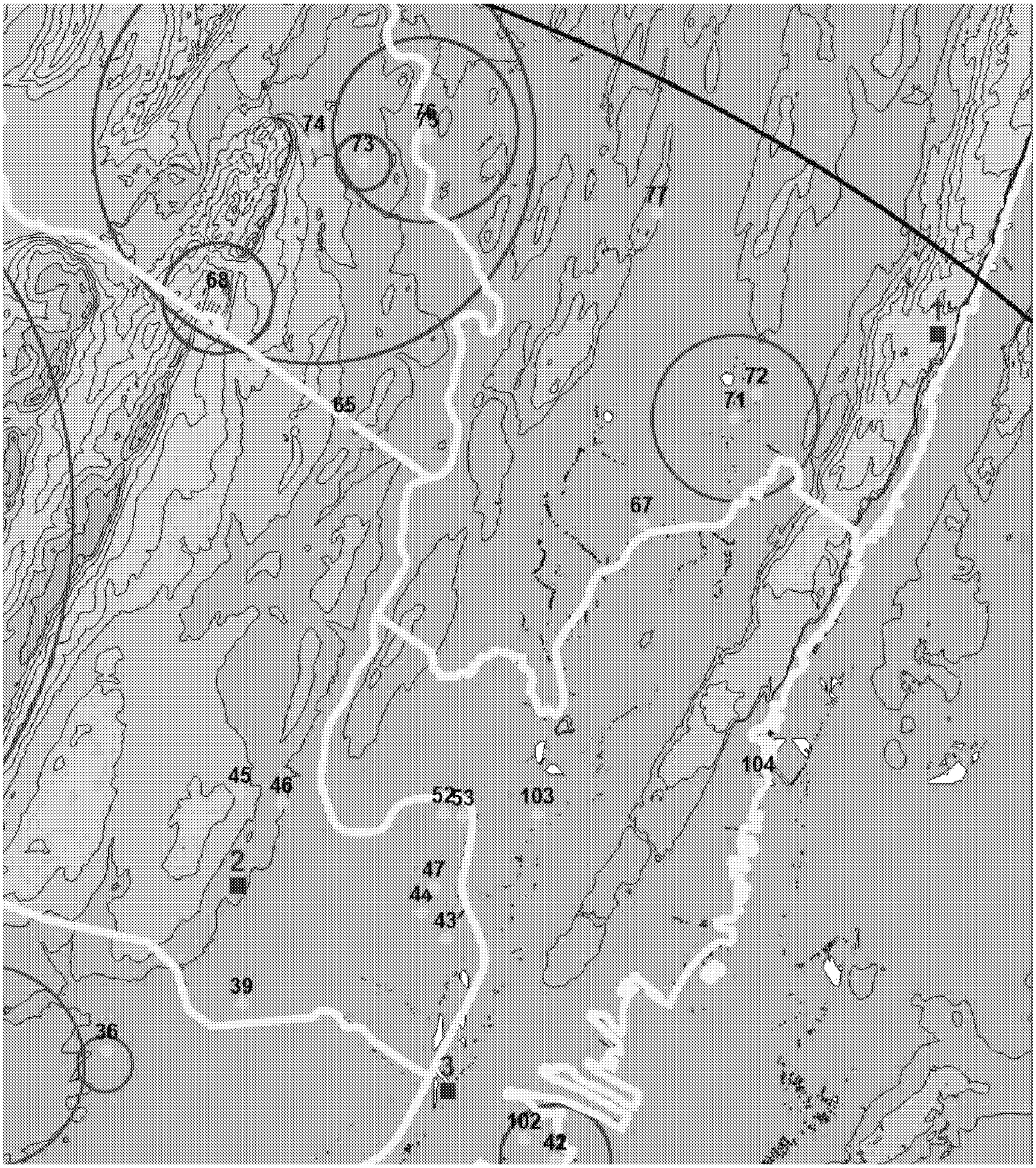
Figure 13: Sources and Ambient Monitors – Newark, Bayonne, Elizabeth



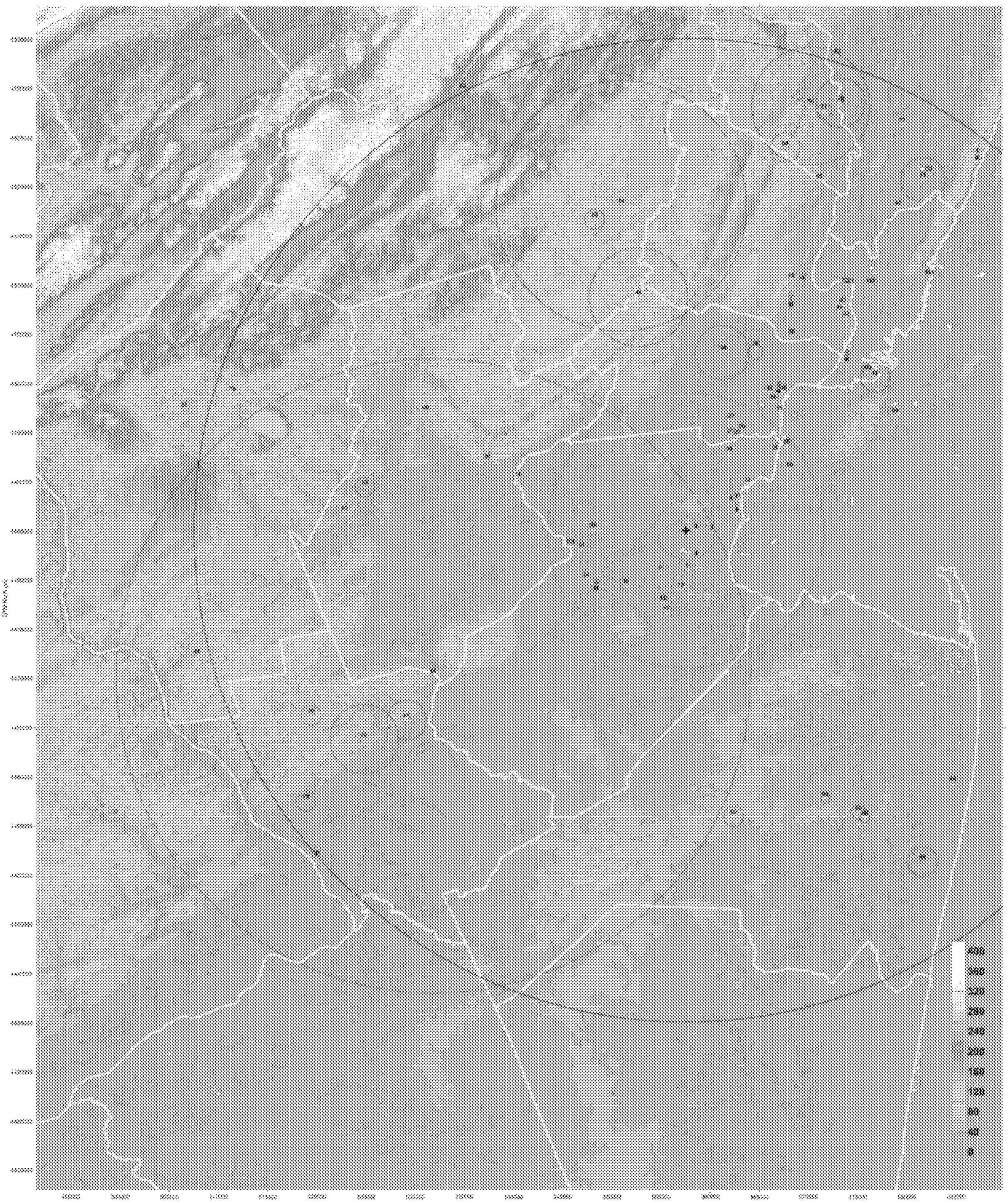
Red squares and red numbers denote the ambient monitors nearest the KEC/WEC facility
2 – Newark
3 – Bayonne
6 – Elizabeth
Blue dots with numbers denote sources

ED_013256A_00001417-00074

Figure 14: Sources and Ambient Monitors – Fort Lee, Newark, Bayonne



Red squares and red numbers denote the ambient monitors nearest the KEC/WEC facility
1 – Fort Lee
2 – Newark
3 – Bayonne
Blue dots with numbers denote sources



Source in NJDEP Inventory

Ambient Background Monitor

Location of Keasbey Energy Center

Basemap: USGS National Elevation Dataset (NED) (Meters)

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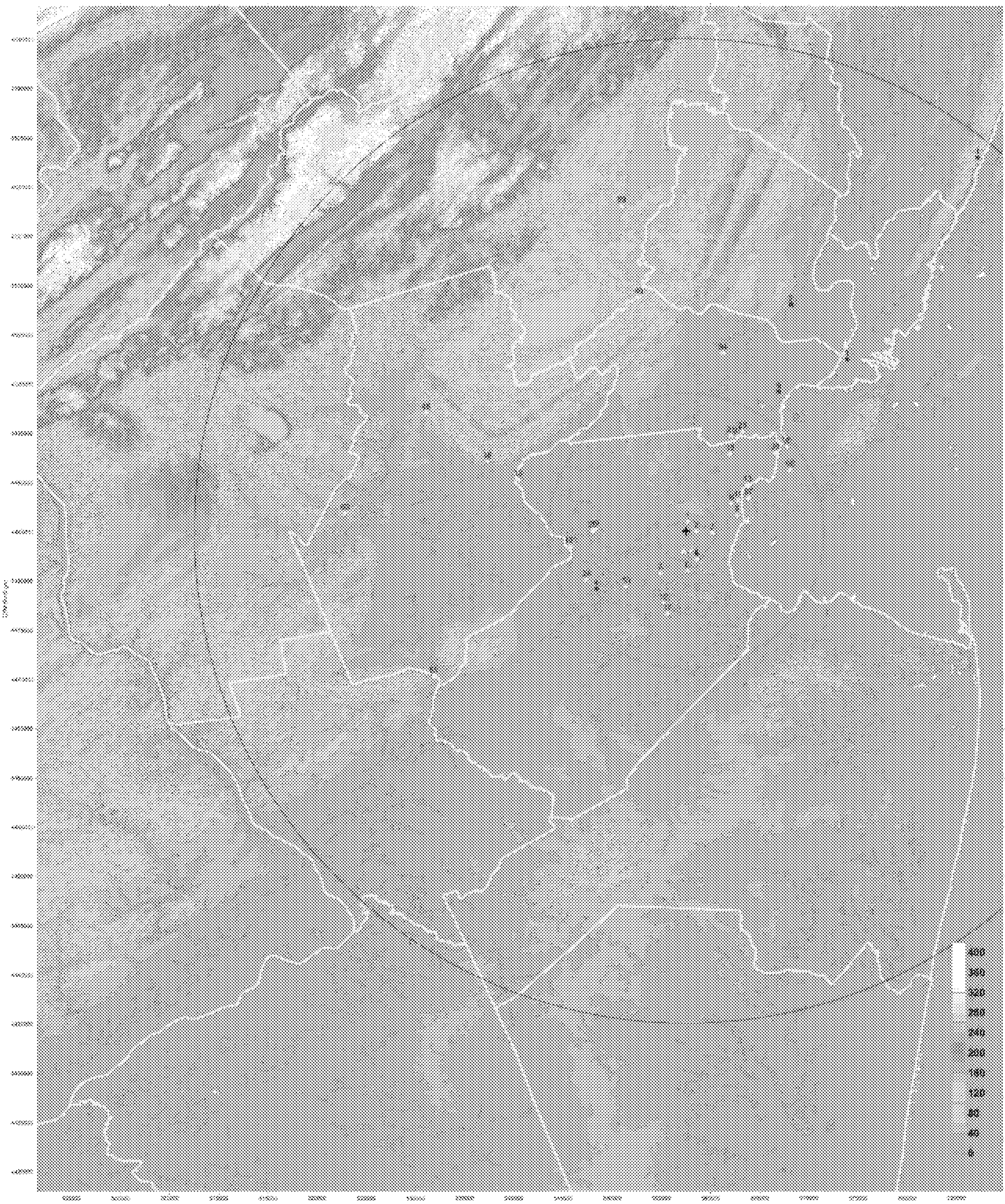
Lyndhurst, NJ 07071
201-933-5541

NO2 MULTISOURCE INVENTORY SCREENING

CPV KEASBEY, LLC
WOODBRIDGE, NEW JERSEY

FIGURE 15 | **SEPTEMBER 2021**



Source in NJDEP Inventory

Ambient Background Monitor

Location of Keasbey Energy Center

Basemap: USGS National Elevation Dataset (NED) (Meters)

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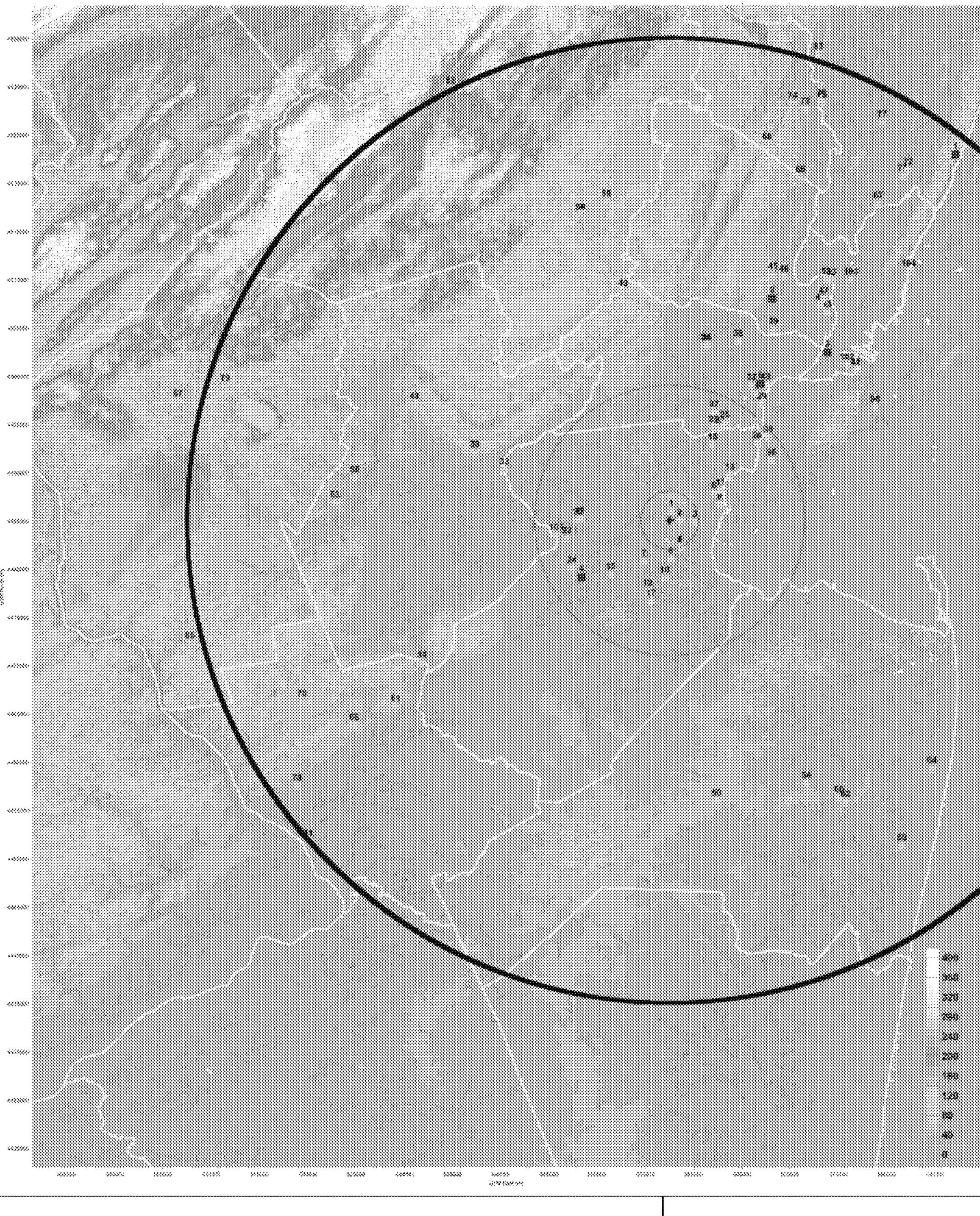
1099 Wall St. West, Suite 250B
Lyndhurst, NJ 07071
201-933-5541

NO2 MULTISOURCE MODELING INVENTORY

CPV KEASBEY, LLC
WOODBRIDGE, NEW JERSEY

FIGURE 16 | **SEPTEMBER 2021**

Appendix A
Modeling Screening Files for 1-Hour NO_2 Screening and Inventory Development



Source in NJDEP Inventory

Ambient Background Monitor

Location of Keasbey Energy Center

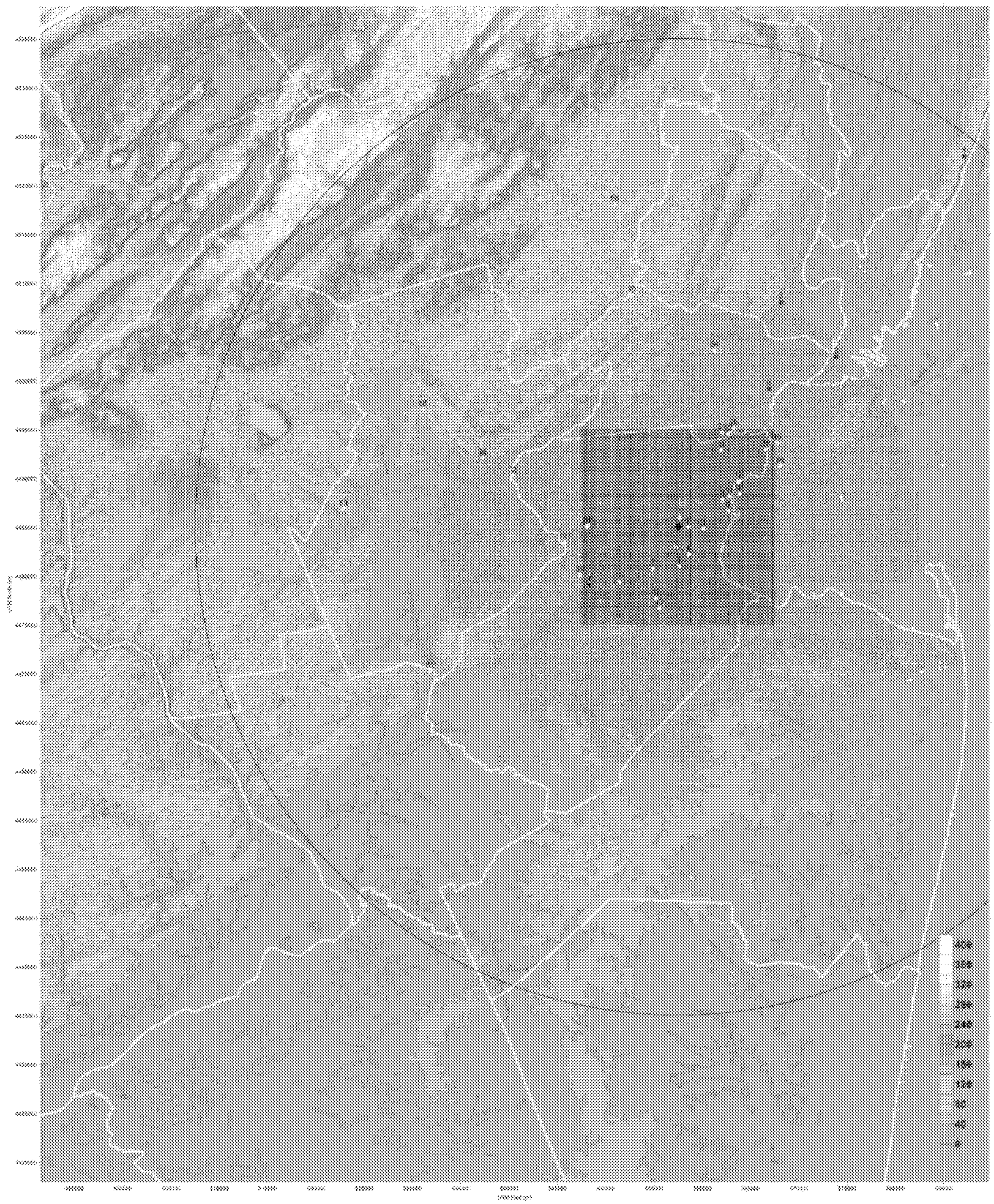
Basemap: USGS National Elevation Dataset (NED) (Meters)

TRC 1099 Wall St. West, Suite 250B
Lyndhurst, NJ 07071
201-933-5541

MULTISOURCE MODELING INVENTORY

CPV KEASBEY, LLC
WOODBRIDGE, NEW JERSEY

FIGURE A-1 | **SEPTEMBER 2021**



Source in NJDEP Inventory

Ambient Background Monitor

Location of Keasbey Energy Center

Basemap: USGS National Elevation Dataset (NED) (Meters)

TRC
1099 Wall St. West, Suite 250B
Lyndhurst, NJ 07071
201-933-5541

NO2 MULTISOURCE MODELING INVENTORY AND RECEPTORS

CPV KEASBEY, LLC
WOODBRIDGE, NEW JERSEY

FIGURE A-2 | **SEPTEMBER 2021**

LEGEND

Cross in center of drawing is location KEC/WEC

Blue dots represent source locations, with name associated with map number as identified on Table 6.

Red squares represent ambient monitors:

#1 ID: 34-003-0010 - Bergen Co - Fort Lee.
#2 ID: 34-013-0003 - Essex Co - Newark.
#3 ID: 34-017-0006 - Hudson Co - Bayonne.
#4 ID: 34-023-0011 - Middlesex Co - East Brunswick.
#6 ID: 34-039-0004 - Union Co - Elizabeth.

Blue circles centered on the NO_2 sources represent the AERMOD refined modeling analysis significant impact areas as described in Step 4 of the NO_2 screening analysis. The impact areas are identified on Table 12 of the protocol and copied here as Table A-1 for convenience.

Inner red circle is 3 kilometers centered on KEC/WEC
Outer red circle is 14 kilometers centered on KEC/WEC

Table A-1: NO_2 Sources with Non-overlapping Significant Impact Areas – Removed by Step 4

Map #	PID	Facility	UTM E (meters)	UTM N (meters)	Distance (meters)	Vector[1] (degrees)	SIA (m)
35	41806	MERCK SHARP & DOHME CORP	561384	4503225	18,534	192	0
36	41735	KEAN UNIVERSITY	564557	4503251	19,848	201	750
41	12863	BAYONNE ENERGY CENTER	576778	4500642	24,751	231	0
42	12174	BAYONNE PLANT HOLDING	576778	4500642	24,751	231	1500
50	21146	NESTLE USA INC BEVERAGEDIVISION	562373	4455974	29,528	351	1000
54	21138	NAVAL WEAPONS STATION EARLE	571679	4457829	30,730	333	500
56	26187	TETCO HANOVER	548269	4516700	32,925	164	0
57	26239	ALGONQUIN GAS TRANSMISSION HANOVER COMP ST	548249	4516707	32,937	164	1000
58	36066	IMCLONE SYSTEMS LLC	524869	4489510	32,943	98	1000
60	21256	MONMOUTH ENERGY INC	575066	4456372	33,665	329	1000
61	61014	TRUSTEES OF PRINCETON UNIVERSITY	529119	4465789	34,340	56	2000
62	21351	MONMOUTH COUNTY RECLAMATION CENTER	575725	4455897	34,415	328	500
64	21323	MONMOUTH UNIVERSITY	584690	4459367	37,426	313	0
65	07167	PB NUTCLIF MASTER, LLC	571064	4520616	38,012	201	0
66	61052	E R SQUIBB & SONS LLC	524812	4463847	39,003	57	3500
68	07524	MONTCLAIR STATE UNIVERSITY	567622	4524004	40,195	195	1500
69	21324	JERSEY SHORE MEDICAL CTR	581595	4451400	41,419	324	1500
70	61053	BRISTOL- MYERS SQUIBB CO	519416	4466273	42,498	64	1000

Table A-1: Sources with Non-overlapping Significant Impact Areas -– Removed by Step 4 (continued)

Map #	PID	Facility	UTM E (meters)	UTM N (meters)	Distance (meters)	Vector[1] (degrees)	SIA (m)
71	02620	BERGEN CNTY UTIL AUTH WTP	581654	4520750	43,054	214	2250
73	31439	CROWN ROLL LEAF INC	571564	4527688	44,845	198	750
74	31669	ST JOSEPH'S HOSPITAL AND MEDICAL CTR	570233	4528242	44,977	196	6000
75	02102	MARCAL MANUFACTURING LLC	573305	4528333	46,026	200	0
76	02624	ELMWOOD PARK POWER LLC	573252	4528565	46,226	200	2500
77	02876	HACKENSACK UNIVERSITY MEDICAL CENTER	579533	4526316	46,728	208	0
78	61008	COLLEGE OF NEW JERSEY	518897	4457561	47,431	55	750
98	NY2640200295	Pouch Terminal -LM6000	578818	4496820	24,314	241	0

(1) Degrees from KEC/WEC towards source (North=0)

Table A-2: Keasbey Energy Center Auxiliary Boiler Exhaust Characteristics and Emissions

Emission Parameter	
Pollutant	**lb/hr**
NO_x	0.72
CO	2.68
PM-10/PM-2.5	0.51
SO_2	0.15
Exhaust Parameter	
Exhaust Height (ft above grade)	40
Exhaust Height (m above grade)	12.19
Exhaust Temperature (deg F)	300
Exhaust Flow (acfm)	22,250
Exhaust Velocity (ft/sec)	52.46
Exhaust Velocity (m/sec)	15.99
Inner Diameter (ft)	3
Inner Diameter (m)	0.91
Stack Base Elevation (ft)	22.5
UTM Easting (m), NAD83, Zone 18	557,541
UTM Northing (m), NAD83, Zone 18	4,485,141

Modeled Emission Rates (g/s)

1-hour CO = 0.34 g/s
1-hour SO_2 = 0.02 g/s
24-hour PM-10/PM-2.5 = 0.06 g/s
1-hour NO_2 = 0.09 g/s
3-hour SO_2 = 0.02 g/s
8-hour CO = 0.34 g/s
24-hour SO_2 = 0.02 g/s
Annual NO_2 = 0.09 g/s x (4000 hours/8760 hours) = 0.041 g/s
Annual PM-10/PM-2.5 = 0.06 g/s x (4000 hours/8760 hours) = 0.027 g/s
Annual SO_2 = 0.02 g/s x (4000 hours x 8760 hours) = 0.009 g/s

Table A-3: Keasbey Energy Center Emergency Diesel Fire Pump Exhaust Characteristics and Emissions

Emission Parameter	
Pollutant	**lb/hr**
NO_x	1.81
CO	0.95
PM-10/PM-2.5	0.08
SO_2	0.003
Exhaust Parameter	
Exhaust Height (ft above grade)	26
Exhaust Height (m above grade)	7.92
Exhaust Temperature (deg F)	1,076
Exhaust Flow (acfm)	1,900
Exhaust Velocity (ft/sec)	90.72
Exhaust Velocity (m/sec)	27.65
Inner Diameter (ft)	0.67
Inner Diameter (m)	0.20
Stack Base Elevation (ft)	22.5
UTM Easting (m), NAD83, Zone 18	557,482
UTM Northing (m), NAD83, Zone 18	4,485,119

Modeled Emission Rates (g/s)

[b]1-hour NO_2 = 0.23 g/s x (100 hours/8760 hours) = 2.63E-3 g/s
1-hour CO = 0.12 g/s
[b]1-hour SO_2 = 0.0004 g/s x (100 hours/8760 hours) = 4.57E-6 g/s
3-hour SO_2 = 0.0004 g/s x (1 hour/3 hours) = 1.33E-4 g/s
8-hour CO = 0.12 g/s x (1 hour/8 hours) = 0.015 g/s
24-hour PM-10/PM-2.5 = 0.01 g/s x (1 hour/24 hours) = 4.17E-4 g/s
24-hour SO_2 = 0.0004 g/s x (1 hour/24 hours) = 1.67E-5 g/s
Annual NO_2 = 0.23 g/s x (100 hours/8760 hours) = 2.63E-3 g/s
Annual PM-10-PM-2.5 = 0.01 g/s x (100 hours/8760 hours) = 1.14E-4 g/s
Annual SO_2 = 0.0004 g/s x (100 hours/8760 hours) = 4.57E-6 g/s

[b]Average hourly emission rate determined by multiplying the maximum hourly emission rate times 100 hours/8760 hours, per the March 1, 2011 guidance memorandum from Tyler Fox (EPA OAQPS) titled "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-Hour NO_2 NAAQS".

Table A-4: Keasbey Energy Center Emergency Diesel Generator Exhaust Characteristics and Emissions

Emission Parameter	
Pollutant	**lb/hr**
NO_x	17.10
CO	9.64
PM-10/PM-2.5	0.55
SO_2	0.037
Exhaust Parameter	
Exhaust Height (ft above grade)	20
Exhaust Height (m above grade)	6.10
Exhaust Temperature (deg F)	759
Exhaust Flow (acfm)	10,908.7
Exhaust Velocity (ft/sec)	231.49
Exhaust Velocity (m/sec)	70.56
Inner Diameter (ft)	1
Inner Diameter (m)	0.30
Stack Base Elevation (ft)	22.5
UTM Easting (m), NAD83, Zone 18	557,564
UTM Northing (m), NAD83, Zone 18	4,485,151

<u>Modeled Emission Rates (g/s)</u>

[b]1-hour NO_2 = 2.15 g/s x (100 hours/8760 hours) = 0.025 g/s
1-hour CO = 1.21 g/s
[b]1-hour SO_2 = 0.0047 g/s x (100 hours/8760 hours) = 5.37E-5 g/s
3-hour SO_2 = 0.0047 g/s x (1 hour/3 hours) = 1.57E-3 g/s
8-hour CO = 1.21 g/s x (1 hour/8 hours) = 0.15 g/s
24-hour PM-10/PM-2.5 = 0.07 g/s x (1 hour/24 hours) = 2.92E-3 g/s
24-hour SO_2 = 0.0047 g/s x (1 hour/24 hours) = 1.96E-4 g/s
Annual NO_2 = 2.15 g/s x (100 hours/8760 hours) = 0.025 g/s
Annual PM-10/PM-2.5 = 0.07 g/s x (100 hours/8760 hours) = 7.99E-4 g/s
Annual SO_2 = 0.0047 g/s x (100 hours/8760 hours) = 5.37E-5 g/s

[b]Average hourly emission rate determined by multiplying the maximum hourly emission rate times 100 hours/8760 hours, per the March 1, 2011 guidance memorandum from Tyler Fox (EPA OAQPS) titled "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-Hour NO_2 NAAQS".

Table A-5: Keasbey Energy Center Cooling Tower Exhaust Characteristics and PM-10/PM-2.5 Emission Rates

Emissions Parameter	
Number of Cells (up to)	10
Maximum Total Air Flow Rate (acfm) (Each Cell)	1,448,000
Maximum Water Flow Rate (gpm) (Total Tower)	153,000
Maximum Drift Rate	0.0005%
Total Solids in Circulating Water (ppm)	6,240
10-cell Total TSP Emission Rate (lb/hr) (Total Tower)	2.39
1-cell TSP Emission Rate (g/s)	0.030
10-cell Total PM-10 Emission Rate (lb/hr) (Total Tower)	1.55
1-cell PM-10 Emission Rate (g/s)	0.020
10-cell Total PM-2.5 Emission Rate (lb/hr) (Total Tower)	0.58
1-cell PM-2.5 Emission Rate (g/s)	0.007
10-cell Total TSP Annual Emission Rate (ton/yr) (Total Tower)	10.46
10-cell Total PM-10 Annual Emission Rate (ton/yr) (Total Tower)	6.81
10-cell Total PM-2.5 Annual Emission Rate (ton/yr) (Total Tower)	2.56
Exhaust Parameter	
Exhaust Height (ft above grade)	54
Exhaust Height (m above grade)	16.46
Collar Height (ft above grade)	40
Collar Height (m above grade)	12.19
Exhaust Temperature (deg F)	80
Exhaust Velocity (ft/sec)	40.63
Exhaust Velocity (m/sec)	12.38
Inner Diameter (ft)	27.5
Inner Diameter (m)	8.38
Base elevation (ft)	22.5

Table A-6: Woodbridge Energy Center Cooling Tower Exhaust Characteristics and PM-10/PM-2.5 Emission Rates

Emissions Parameter	
Number of Cells	14
Maximum Total Air Flow Rate (acfm) (Each Cell)	1,341,000
Maximum Water Flow Rate (gpm) (Total Tower)	148,000
Maximum Drift Rate	0.0005%
Total Solids in Circulating Water (ppm)	6,240
14-cell Total TSP Emission Rate (lb/hr) (Total Tower)	2.31
1-cell TSP Emission Rate (g/s)	0.021
14-cell Total PM-10 Emission Rate (lb/hr) (Total Tower)	1.5
1-cell PM-10 Emission Rate (g/s)	0.014
14-cell Total PM-2.5 Emission Rate (lb/hr) (Total Tower)	0.56
1-cell PM-2.5 Emission Rate (g/s)	0.005
14-cell Total TSP Annual Emission Rate (ton/yr) (Total Tower)	10.12
14-cell Total PM-10 Annual Emission Rate (ton/yr) (Total Tower)	6.58
14-cell Total PM-2.5 Annual Emission Rate (ton/yr) (Total Tower)	2.43
Exhaust Parameter	
Exhaust Height (ft above grade)	55
Exhaust Height (m above grade)	16.76
Collar Height (ft above grade)	41.85
Collar Height (m above grade)	12.76
Exhaust Temperature (deg F)	85
Exhaust Velocity (ft/sec)	31.62
Exhaust Velocity (m/sec)	9.64
Inner Diameter (ft)	30
Inner Diameter (m)	9.14
Base elevation (ft)	19.5

Table A-7: Woodbridge Energy Center Auxiliary Boiler Exhaust Characteristics and Emissions

Emission Parameter	
Pollutant	**lb/hr**
NO_X	0.92
CO	3.44
PM-10/PM-2.5	0.46
SO_2	0.16
Exhaust Parameter	
Exhaust Height (ft above grade)	40
Exhaust Height (m above grade)	12.19
Exhaust Temperature (deg F)	310
Exhaust Velocity (ft/sec)	57.3
Exhaust Velocity (m/sec)	17.5
Inner Diameter (ft)	3.3
Inner Diameter (m)	0.99
Stack Base Elevation (ft)	19.5
UTM Easting (m), NAD83, Zone 18	557,636
UTM Northing (m), NAD83, Zone 18	4,485,176

Modeled Emission Rates (g/s)

1-hour CO = 0.43 g/s
1-hour SO_2 = 0.02 g/s
24-hour PM-10/PM-2.5 = 0.06 g/s
1-hour NO_2 = 0.12 g/s
3-hour SO_2 = 0.02 g/s
8-hour CO = 0.43 g/s
24-hour SO_2 = 0.02 g/s
Annual NO_2 = 0.12 g/s x (2000 hours/8760 hours) = 0.027 g/s
Annual SO_2 = 0.02 g/s x (2000 hours/8760 hours) = 0.005 g/s
Annual PM-10/PM-2.5 = 0.06 g/s x (2000 hours/8760 hours) = 0.014 g/s

Table A-8: Woodbridge Energy Center Emergency Diesel Fire Pump Exhaust Characteristics and Emissions

Emission Parameter	
Pollutant	**lb/hr**
NO_x	1.93
CO	1.81
PM-10/PM-2.5	0.10
SO_2	0.003
Exhaust Parameter	
Exhaust Height (ft above grade)	20
Exhaust Height (m above grade)	6.10
Exhaust Temperature (deg F)	961
Exhaust Velocity (ft/sec)	171.1
Exhaust Velocity (m/sec)	52.2
Inner Diameter (ft)	0.4
Inner Diameter (m)	0.13
Stack Base Elevation (ft)	19.5
UTM Easting (m), NAD83, Zone 18	557,604
UTM Northing (m), NAD83, Zone 18	4,485,216

Modeled Emission Rates (g/s)

[b]1-hour NO_2 = 0.24 g/s x (100 hours/8760 hours) = 2.74E-3 g/s
1-hour CO = 0.23 g/s
[b]1-hour SO_2 = 0.0004 g/s x (100 hours/8760 hours) = 4.57E-6 g/s
3-hour SO_2 = 0.0004 g/s x (1 hour/3 hours) = 1.33E-4 g/s
8-hour CO = 0.23 g/s x (1 hour/8 hours) = 0.029 g/s
24-hour PM-10/PM-2.5 = 0.01 g/s x (1 hour/24 hours) = 4.17E-4 g/s
24-hour SO_2 = 0.0004 g/s x (1 hour/24 hours) = 1.67E-5 g/s
Annual NO_2 = 0.24 g/s x (100 hours/8760 hours) = 2.74E-3 g/s
Annual PM-10/PM-2.5 = 0.01 g/s x (100 hours/8760 hours) = 1.14E-4 g/s
Annual SO_2 = 0.0004 g/s x (100 hours/8760 hours) = 4.57E-6 g/s

[b]Average hourly emission rate determined by multiplying the maximum hourly emission rate times 100 hours/8760 hours, per the March 1, 2011 guidance memorandum from Tyler Fox (EPA OAQPS) titled "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-Hour NO_2 NAAQS".

Table A-9: Woodbridge Energy Center Emergency Diesel Generator Exhaust Characteristics and Emissions

Emission Parameter	
Pollutant	**lb/hr**
NO_x	21.16
CO	1.99
PM-10/PM-2.5	0.13
SO_2	0.0208
Exhaust Parameter	
Exhaust Height (ft above grade)	30
Exhaust Height (m above grade)	9.14
Exhaust Temperature (deg F)	763.5
Exhaust Velocity (ft/sec)	528.1
Exhaust Velocity (m/sec)	161.0
Inner Diameter (ft)	0.7
Inner Diameter (m)	0.20
Stack Base Elevation (ft)	19.5
UTM Easting (m), NAD83, Zone 18	557,679
UTM Northing (m), NAD83, Zone 18	4,485,227

Modeled Emission Rates (g/s)

[b]1-hour NO_2 = 2.67 g/s x (100 hours/8760 hours) = 0.03 g/s
1-hour CO = 0.25 g/s
[b]1-hour SO_2 = 0.003 g/s x (100 hours/8760 hours) = 3.42E-5 g/s
3-hour SO_2 = 0.003 g/s x (1 hour/3 hours) = 0.001 g/s
8-hour CO = 0.25 g/s x (1 hour/8 hours) = 0.03 g/s
24-hour PM-10/PM-2.5 = 0.02 g/s x (1 hour/24 hours) = 8.33E-4 g/s
24-hour SO_2 = 0.003 g/s x (1 hour/24 hours) = 1.25E-4 g/s
Annual NO_2 = 2.67 g/s x (100 hours/8760 hours) = 0.03 g/s
Annual PM-10-PM-2.5 = 0.02 g/s x (100 hours/8760 hours) = 2.28E-4 g/s
Annual SO_2 = 0.003 g/s x (100 hours/8760 hours) = 3.42E-5 g/s

[b]Average hourly emission rate determined by multiplying the maximum hourly emission rate times 100 hours/8760 hours, per the March 1, 2011 guidance memorandum from Tyler Fox (EPA OAQPS) titled "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-Hour NO_2 NAAQS".

Message

From: Petriman, Viorica [Petriman.Viorica@epa.gov]
Sent: 7/26/2021 1:33:56 PM
To: Colecchia, Annamaria [Colecchia.Annamaria@epa.gov]
CC: Chan, Suilin [Chan.Suilin@epa.gov]; Sareen, Neha [sareen.neha@epa.gov]
Subject: Draft Permit - Astoria Gas Turbine Power (R2 DEC)
Attachments: Astoria Gas Turbine LLC Air Permit Application Revision 5-28-2021.pdf

Annamaria,

Here is the application for Astoria Gas Turbine Power draft title V & PSD and NNSR permits, which I just received from DEC. It contains air quality impact analysis/modeling for particulates (PM10, PM2.5) as well. You recall that I briefly let you know about it. I will review the draft permit and all other stuff, except for the air quality impact analysis. *Suilin may want to decide whether she wants the modeling part reviewed.*

The public comment began on 6/30/2021 and it will end 8/29/2021, but DEC didn't notify us. I found out about it on 7/19 by checking DEC web site and I immediately asked DEC for application. I took DEC 1 week to send us the application. So, practically, we are let with only one month to review it.

Viorica

Message

From: Sareen, Neha [sareen.neha@epa.gov]
Sent: 3/29/2021 6:38:27 PM
To: Colecchia, Annamaria [Colecchia.Annamaria@epa.gov]
Subject: FW: Keasbey Energy Center Project (Facility ID 18940, Permit Activity BOP160004) - Air Quality Modeling Protocol (Revision 3)
Attachments: FINAL_Revised CPV Keasbey_AQ Protocol_030217.pdf; CPV Keasbey Energy Center Single Source Modeling Protocol March 2017.pdf

FYI, a copy of Keasbey's 1st approved protocol.

From: John, Greg <Greg.John@dep.nj.gov>
Sent: Monday, March 29, 2021 1:36 PM
To: Sareen, Neha <sareen.neha@epa.gov>
Cc: Zhang, Yiling <Yiling.Zhang@dep.nj.gov>
Subject: RE: Keasbey Energy Center Project (Facility ID 18940, Permit Activity BOP160004) - Air Quality Modeling Protocol (Revision 3)

Neha,

The final version of the single source protocol and conditional approval memo are attached.

Greg

From: Sareen, Neha <sareen.neha@epa.gov>
Sent: Monday, March 29, 2021 10:22 AM
To: Zhang, Yiling <Yiling.Zhang@dep.nj.gov>
Cc: John, Greg <Greg.John@dep.nj.gov>
Subject: [EXTERNAL] RE: Keasbey Energy Center Project (Facility ID 18940, Permit Activity BOP160004) - Air Quality Modeling Protocol (Revision 3)

Greg, only if you have it handy; don't worry if it's not easily accessible. Thanks.

From: Zhang, Yiling <Yiling.Zhang@dep.nj.gov>
Sent: Monday, March 29, 2021 9:11 AM
To: Sareen, Neha <sareen.neha@epa.gov>
Cc: greg.john@dep.nj.gov
Subject: Re: Keasbey Energy Center Project (Facility ID 18940, Permit Activity BOP160004) - Air Quality Modeling Protocol (Revision 3)

Good Morning Neha,

Greg and I were both out of the office last Friday. Sorry for this late reply.

I don't have the old files since I am new to this project.

Greg, do you have access to the old version of the single source protocol?

Thanks,
Yiling

From: Sareen, Neha <sareen.neha@epa.gov>
Sent: Friday, March 26, 2021 1:34 PM
To: Zhang, Yiling <Yiling.Zhang@dep.nj.gov>
Subject: [EXTERNAL] RE: Keasbey Energy Center Project (Facility ID 18940, Permit Activity BOP160004) - Air Quality Modeling Protocol (Revision 3)

Hi Yiling,

Do you happen to have a digital copy of the single source protocol that was approved before? I think we might have only had a physical copy and that is in the office. Wanted to just compare some of the things.

Thank you!

From: Zhang, Yiling <Yiling.Zhang@dep.nj.gov>
Sent: Tuesday, March 23, 2021 6:59 PM
To: Sareen, Neha <sareen.neha@epa.gov>; greg.john@dep.nj.gov; Colecchia, Annamaria <Colecchia.Annamaria@epa.gov>
Subject: Re: Keasbey Energy Center Project (Facility ID 18940, Permit Activity BOP160004) - Air Quality Modeling Protocol (Revision 3)

Thanks Neha.

From: Sareen, Neha <sareen.neha@epa.gov>
Sent: Tuesday, March 23, 2021 3:06 PM
To: Zhang, Yiling <Yiling.Zhang@dep.nj.gov>; John, Greg <Greg.John@dep.nj.gov>; Colecchia, Annamaria <Colecchia.Annamaria@epa.gov>
Subject: [EXTERNAL] RE: Keasbey Energy Center Project (Facility ID 18940, Permit Activity BOP160004) - Air Quality Modeling Protocol (Revision 3)

Hi Yiling,

That sounds reasonable to us; we'll share our comments with you prior to two weeks.

Thank you,
Neha

From: Zhang, Yiling <Yiling.Zhang@dep.nj.gov>
Sent: Tuesday, March 23, 2021 11:02 AM
To: Sareen, Neha <sareen.neha@epa.gov>; greg.john@dep.nj.gov; Colecchia, Annamaria <Colecchia.Annamaria@epa.gov>
Subject: Re: Keasbey Energy Center Project (Facility ID 18940, Permit Activity BOP160004) - Air Quality Modeling Protocol (Revision 3)

Good Morning Neha,

We are in the process of reviewing Keasbey's revised modeling protocol. I have not seen major issues. How is your review going?

The permit program is preparing progress schedules for this project, and the modeling group is thinking about completing this protocol review within two weeks. Would this schedule work for you?

Thanks,
Yiling

From: Sareen, Neha <sareen.neha@epa.gov>
Sent: Monday, March 8, 2021 5:11 PM
To: John, Greg <Greg.John@dep.nj.gov>; Zhang, Yiling <Yiling.Zhang@dep.nj.gov>; Colecchia, Annamaria <Colecchia.Annamaria@epa.gov>
Subject: [EXTERNAL] RE: Keasbey Energy Center Project (Facility ID 18940, Permit Activity BOP160004) - Air Quality Modeling Protocol (Revision 3)

Thanks for this clarification Greg!

From: John, Greg <Greg.John@dep.nj.gov>
Sent: Monday, March 8, 2021 4:25 PM
To: Sareen, Neha <sareen.neha@epa.gov>; Zhang, Yiling <Yiling.Zhang@dep.nj.gov>; Colecchia, Annamaria <Colecchia.Annamaria@epa.gov>
Subject: Re: Keasbey Energy Center Project (Facility ID 18940, Permit Activity BOP160004) - Air Quality Modeling Protocol (Revision 3)

Neha,

Keasbey still has not identified their offsets. So, in the meantime, the NJDEP is making them redo their modeling because so much time has passed since the initial modeling was submitted. Since a number of items (i.e., startup/shutdown scenario, model version, background AQ, met data, multisource source inventory) have changed since they started, the NJDEP has asked for remodeling starting from scratch with the single source (facility) modeling protocol.

Greg

From: Sareen, Neha <sareen.neha@epa.gov>
Sent: Monday, March 8, 2021 4:09 PM
To: Zhang, Yiling <Yiling.Zhang@dep.nj.gov>; Colecchia, Annamaria <Colecchia.Annamaria@epa.gov>
Cc: John, Greg <Greg.John@dep.nj.gov>
Subject: [EXTERNAL] RE: Keasbey Energy Center Project (Facility ID 18940, Permit Activity BOP160004) - Air Quality Modeling Protocol (Revision 3)

Hi Yiling,

Can you clarify if Keasbey is making changes to their configuration/emission rates or something else significant and hence they are starting from scratch with the single source protocol? Last we remember, they were trying to get offsets for the multisource modeling they had done.

Thanks,
Neha

From: Zhang, Yiling <Yiling.Zhang@dep.nj.gov>
Sent: Wednesday, March 3, 2021 7:18 PM
To: Sareen, Neha <sareen.neha@epa.gov>; Colecchia, Annamaria <Colecchia.Annamaria@epa.gov>

Cc: greg.john@dep.nj.gov
Subject: Re: Keasbey Energy Center Project (Facility ID 18940, Permit Activity BOP160004) - Air Quality Modeling Protocol (Revision 3)

Thanks.

From: Sareen, Neha <sareen.neha@epa.gov>
Sent: Wednesday, March 3, 2021 5:56 PM
To: Zhang, Yiling <Yiling.Zhang@dep.nj.gov>; Colecchia, Annamaria <Colecchia.Annamaria@epa.gov>
Cc: John, Greg <Greg.John@dep.nj.gov>
Subject: [EXTERNAL] RE: Keasbey Energy Center Project (Facility ID 18940, Permit Activity BOP160004) - Air Quality Modeling Protocol (Revision 3)

Thank you Yiling. We'll take a look and provide comments. So this is single source protocol; they are redoing everything?

Best,
Neha

From: Zhang, Yiling <Yiling.Zhang@dep.nj.gov>
Sent: Tuesday, March 2, 2021 12:45 PM
To: Sareen, Neha <sareen.neha@epa.gov>; Colecchia, Annamaria <Colecchia.Annamaria@epa.gov>
Cc: greg.john@dep.nj.gov
Subject: Fw: Keasbey Energy Center Project (Facility ID 18940, Permit Activity BOP160004) - Air Quality Modeling Protocol (Revision 3)

Hi Neha and Annamaria,

Please see the forwarded project from Keasbey.

Thanks,
Yiling

From: Ometz, Darin <DOmetz@trccompanies.com>
Sent: Thursday, February 18, 2021 9:40 AM
To: John, Greg <Greg.John@dep.nj.gov>
Cc: Zhang, Yiling <Yiling.Zhang@dep.nj.gov>; Owen, David <David.Owen@dep.nj.gov>; Andrew Urquhart <aurquhart@cpv.com>; Leon, Joel <Joel.Leon@dep.nj.gov>; Khan, Aliya <Aliya.Khan@dep.nj.gov>; Keller, Michael <MKeller@trccompanies.com>
Subject: [EXTERNAL] Keasbey Energy Center Project (Facility ID 18940, Permit Activity BOP160004) - Air Quality Modeling Protocol (Revision 3)

Greg,

TRC is submitting the attached revised Air Quality Modeling Protocol (Revision 3) for the Keasbey Energy Center Project (Facility ID 18940, Permit Activity BOP160004) in response to the Department's October 29, 2020 notice of technical deficiency. As you are aware and were a participant to, the NJDEP and CPV Keasbey had a virtual meeting on November 17, 2020 to discuss the Department's expectations with regards to updating the air dispersion modeling protocol, analysis, and report.

As requested, the revised Air Quality Modeling Protocol includes the necessary updates to the U.S. EPA dispersion model versions, updates to the meteorological and background monitoring concentration data, and updates to the facility emissions and design details that were provided in the single source air quality modeling analysis report (September 2017) and approved on November 20, 2017. To facilitate the Department's review of the changes incorporated in the revised Air Quality Modeling Protocol (Revision 3 – February 2021) from the approved Air Quality Modeling Protocol (Revision 2 – March 2017), the cover letter provides brief descriptions of the requested updates for your consideration.

If you have any questions concerning the attached air quality modeling protocol, please feel free to call me at (201) 508-6964. We look forward to receiving the Department's review comments/approval, as well as the opportunity to continue working with you on this project.

Regards,
Darin

Darin Ometz
Senior Air Quality Project Manager

TRC
1099 Wall Street West, Suite 250B, Lyndhurst, NJ 07071
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AIR QUALITY MODELING PROTOCOL

Prepared for the

CPV Keasbey, LLC
Keasbey Energy Center
Combined Cycle Power Facility
Township of Woodbridge, Middlesex County,
New Jersey

Submitted to

New Jersey Department of Environmental Protection
Trenton, New Jersey

Prepared by

TRC
1200 Wall Street West, 5th Floor
Lyndhurst, New Jersey 07071

August 2016
Revised December 2016
Revised March 2017

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Appendix A: Agency Correspondence

1.0 INTRODUCTION

CPV Power Holdings, LP (CPV) is a leading North American electric power generation development and asset management company headquartered in Silver Spring, Maryland with offices in Braintree, Massachusetts and San Francisco, California. CPV Keasbey, LLC (CPV Keasbey), a wholly owned business entity of CPV, is proposing to construct a nominal 630-megawatt (MW) dual fuel (natural gas and ultra-low sulfur diesel – ULSD) fired 1-on-1 combined cycle electric power facility, to be known as the Keasbey Energy Center (the Project), on land directly adjacent to the existing 725 MW Woodbridge Energy Center.

The proposed Project will be constructed on an approximately eleven (11) acre parcel of land (the "Property") located at 1070 Riverside Drive Township of Woodbridge, Middlesex County, New Jersey (Block 93, Lot 100.02 on the official Woodbridge Township Tax Maps). The Property is located within the Keasbey Brownfield Redevelopment Area on a former chemical plant site that has undergone clean-up and remediation pursuant to the NJDEP's Site Remediation Program. The Property will be sub-divided from the approximately 27.5 acre parcel of land controlled by CPV Shore Urban Renewal, LLC and shares a property boundary with CPV Shore, LLC's (CPV Shore) Woodbridge Energy Center.

The Project air contaminant emissions sources will include a single dual-fuel fired combustion turbine with a natural gas supplementary-fired heat recovery steam generator (HRSG); a natural gas-fired auxiliary boiler, and; an emergency diesel generator and emergency diesel fire pump. Combined cycle power will be generated from a steam turbine generator serviced by a wet evaporative cooling tower. The Project will be permitted as a major modification to an existing major source, CPV Shore's Woodbridge Energy Center (PID # 18940 Woodbridge Energy Center) due to CPV's common control of both facilities. CPV's common control of both facilities arises from CPV's majority ownership in both CPV Keasbey and CPV Shore, where CPV controls 100% ownership interest in CPV Keasbey and currently has an approximate 57.5% ownership interest in CPV Shore. For this reason, CPV is considered to have common control of both facilities.

The proposed Project is located in an attainment area for sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), particulate matter with an aerodynamic diameter less than 10 micrometers (um) (PM-10), and particulate matter with an aerodynamic diameter less than 2.5 um (PM-2.5). Since the Project will potentially emit in excess of the Significant Emission Rates (per year of several air pollutants), it will be subject to Prevention of Significant Deterioration (PSD) permitting. Emissions of sulfur dioxide (SO_2), nitrogen dioxide (NO_2), sulfuric acid (H_2SO_4), PM-10, PM-2.5, and CO will exceed the pollutant specific PSD significant emission rates (SER) and, consequently, a Best Available Control Technology (BACT) analysis and an air dispersion modeling analysis is required for these pollutants.

Middlesex County is designated as moderate non-attainment for the 8-hour ozone standard. Since potential annual emissions of NO_x and VOC, both ozone precursors, exceed the major source thresholds (i.e., 25 tons per year of NO_x and/or 25 tons per year of VOC), the proposed facility is subject to non-attainment New Source Review (NSR) for these two ozone precursors. Consequently, a Lowest Achievable Emission Rate (LAER) analysis (for NO_x and VOC) is required.

An air quality analysis is required to demonstrate that the proposed facility (Keasbey Energy Center) and the existing Woodbridge Energy Center will be compliant with all applicable PSD increment levels, National Ambient Air Quality Standards (NAAQS), and New Jersey Ambient Air Quality Standards (NJAAQS). Initially, the combined air quality impacts of the proposed Keasbey Energy Center and the existing Woodbridge Energy Center will be modeled using potential emission rates to determine if the combined facilities will yield significant air quality impacts (i.e., maximum modeled concentrations greater than the PSD significant impact concentrations).

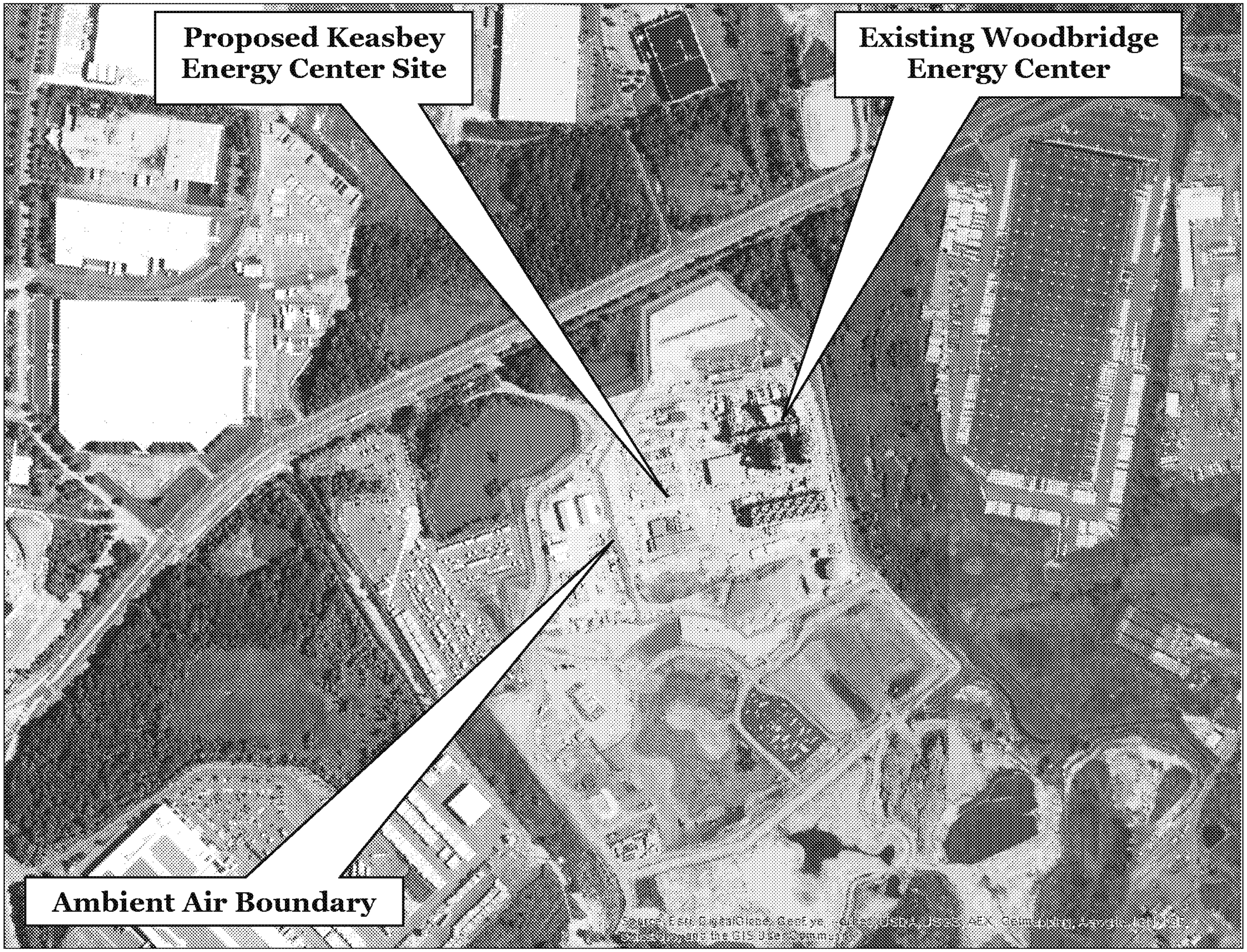
The significance modeling for both the proposed Keasbey Energy Center and existing Woodbridge Energy Center will be performed for multiple operating loads and ambient temperatures. The pollutant-specific "worst-case" operating scenario(s) determined from the Keasbey Energy Center significance modeling analysis coupled with the pollutant-specific "worst-case" operating scenarios determined from the Woodbridge Energy Center significance modeling analysis will be used in all subsequent modeling, including any PSD increment and multiple source NAAQS/NJAAQS analyses, if necessary.

2.0 AREA DESCRIPTION

The proposed Keasbey Energy Center will be located on a parcel of land controlled by CPV Shore Urban Renewal, LLC located in the Township of Woodbridge, Middlesex County, New Jersey (see Figure 2-1). The project site's eastern border is immediately adjacent to the Woodbridge Energy Center operated by CPV Shore, LLC. Existing land uses in the vicinity of the proposed site include industrial development, commercial development, neighborhood businesses, and residential neighborhoods. The nearest residential locations are approximately 0.8 miles (1.3 kilometers) to the northeast, along Sunnyview Oval immediately north of Route 440 and along King Georges Post Road immediately south of Route 440. Access to the property is provided directly from Riverside Drive.

The proposed facility site is located along the northwestern edge of the Atlantic Coastal Plain Province in New Jersey. Terrain elevations in this Province range from sea level to 391 feet above mean sea level (MSL), at Crawford Hill, Holmdel, New Jersey. Topography in the immediate area is generally flat, with elevations at sea level on the Raritan River and elevations rising upwards of and exceeding 200 feet in Fords, New Jersey. The elevation of the proposed facility site is approximately 22.5 feet above MSL.

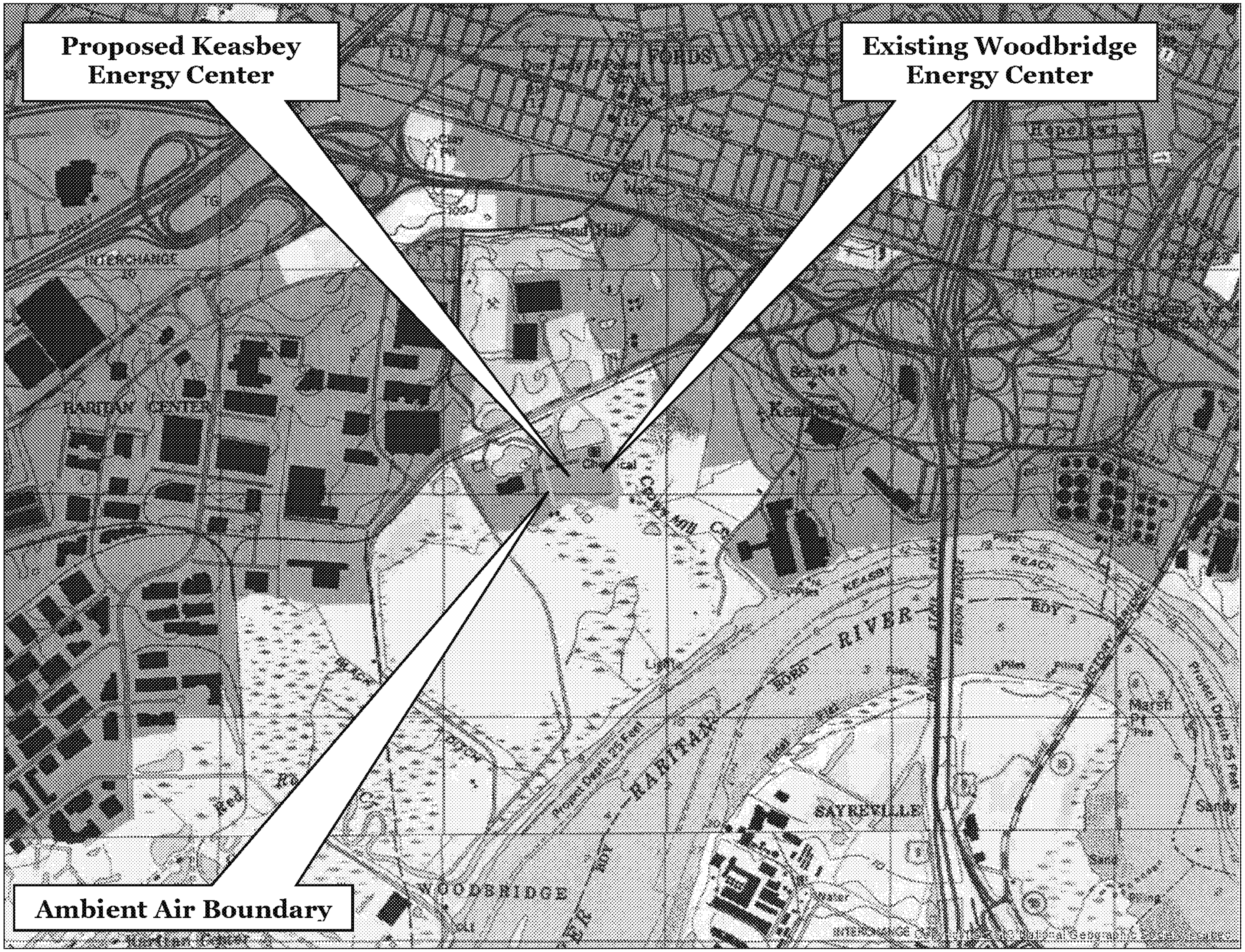
The proposed facility will be located at approximately 40° 30' 53" North Latitude, 74° 19' 16" West Longitude, North American Datum 1983 (NAD83). The approximate Universal Transverse Mercator (UTM) coordinates of the proposed facility are 557,515 meters Easting, 4,485,100 meters Northing, in Zone 18, NAD83. Figure 2-2 shows the proposed facility location and the surrounding area.



Keasbey Energy Center
Proposed Combined Cycle Power Facility
Township of Woodbridge, Middlesex County, New Jersey

Figure 2-1. Site Location Aerial Photograph

Source: Esri, Digital Globe, GeoEye, 2017.



Note: The red regions denote developed areas of medium intensity (i.e., single family housing units) and high intensity (i.e., apartments, row houses, and commercial/industrial).

Keasbey Energy Center
Proposed Combined Cycle Power Facility
Township of Woodbridge, Middlesex County, New Jersey

Figure 2-2. Site Location Map

Source: USGS 7.5 Minute Quadrangle Maps

TRC

3.0 FACILITY DESCRIPTION

3.1 Equipment

The proposed Keasbey Energy Center will consist of one (1) General Electric (GE) 7HA.02 combustion turbine at the proposed facility site. The maximum heat input for this turbine firing natural gas (design basis assumes sulfur in fuel is 0.63 grains/100 SCF at 1,024 Btu/SCF) at -8 degrees Fahrenheit (deg F) is 3,664 million British Thermal Units per hour (mmBTU/hr), Higher Heating Value (HHV). The maximum combustion turbine heat input capacity at -8 degrees Fahrenheit (°F) ambient temperature firing ULSD is 3,702 million British thermal units per hour (MMBtu/hr) based on the Higher Heating Value (HHV). Hot exhaust gases from the combustion turbine will flow into an adjacent heat recovery steam generator (HRSG) that will be equipped with a natural gas fired duct burner. The maximum duct burner heat input capacity firing natural gas is 850 million British thermal units per hour (MMBtu/hr) based on the Higher Heating Value (HHV). The HRSG will produce steam to be used in the steam turbine. Upon leaving the HRSG, the turbine exhaust gases will be directed to one (1) exhaust stack. Other ancillary equipment at the proposed facility will include a gas-fired auxiliary boiler, an emergency diesel fire pump, an emergency diesel generator, and a wet mechanical draft cooling tower. The auxiliary boiler is sized up to 72.3 mmBtu/hr, will fire natural gas exclusively, and operate for up to 4,000 hours per year. The emergency diesel fire pump is sized up to 2.3 mmBtu/hr (305 hp), will fire ULSD, and operate up to 100 hours per year for testing and maintenance. The emergency diesel generator is sized up to 14.4 mmBtu/hr, will fire ULSD, and operate up to 100 hours per year for testing and maintenance.

Emissions from the combined cycle unit will be controlled by the use of dry low-NO_x burner technology (during natural gas firing), water injection (during ULSD firing), and SCR for NO_x control; an oxidation catalyst for CO and VOC control; and the use of clean low-sulfur fuels (i.e., natural gas and ULSD) to minimize emissions of SO_2, PM/PM-10/PM-2.5, and H_2SO_4. Steam from the steam turbine will be sent to a condenser where it will be cooled to a liquid state and returned to the HRSG. Waste heat from the condenser will be dissipated through the wet mechanical draft cooling tower.

The existing Woodbridge Energy Center consists of two (2) General Electric (GE) 7FA.05 combustion turbines. The maximum heat input for each turbine firing natural gas is 2,307 million British Thermal Units per hour (mmBTU/hr), Higher Heating Value (HHV). Hot exhaust gases from each of the combustion turbines flow into adjacent heat recovery steam generators (HRSGs) that are equipped with natural gas fired duct burners. The maximum duct burner heat input capacity firing natural gas (for each duct burner) is 500 million British thermal units per hour (MMBtu/hr) based on the Higher Heating Value (HHV). . The HRSGs produce steam to be used in the steam turbine. Upon leaving the HRSGs, the turbine exhaust gases are directed to two (2) exhaust stacks. Other ancillary equipment at the existing Woodbridge Energy Center includes a gas-fired auxiliary boiler, an emergency diesel fire pump, an emergency diesel generator, and a wet mechanical draft cooling tower. The auxiliary boiler is sized up to 91.6 mmBtu/hr, fires natural gas exclusively, and operates for up to 2,000 hours per year. The emergency diesel fire pump is sized up to 2.1 mmBtu/hr, fires ULSD, and operates up to 100 hours per year for testing and maintenance. The emergency diesel generator is sized up to 13.5 mmBtu/hr, fires ULSD, and operates up to 100 hours per year for testing and maintenance.

Emissions from the combined cycle units are controlled by the use of dry low-NO_x burner technology (during natural gas firing) and SCR for NO_x control; an oxidation catalyst for CO and VOC control; and the use of clean low-sulfur fuels (i.e., natural gas) to minimize emissions of SO_2, PM/PM-10/PM-2.5, and H_2SO_4. Steam from the steam turbine is sent to a condenser where it is cooled to a liquid state and returned to the HRSGs. Waste heat from the condensers is dissipated through the 14-cell wet mechanical draft cooling tower.

3.2 Fuels

CPV Keasbey is proposing to utilize natural gas as the primary fuel for the combustion turbine at Keasbey Energy Center. The natural gas is assumed to have a HHV of 1,024 Btu/standard cubic foot (scf) and an estimated sulfur content of 0.63 grains per 100 scf and is used for the basis of facility design and by GE in establishing emission calculations. Natural gas sulfur content data was reviewed for the TETCO and TRANSCO gas suppliers. The TETCO data spans from October 1, 2013 to October 18, 2016, a period slightly more than three years. The TRANSCO data spans June 1, 2014 through June 7, 2016, a period slightly more than two years. This data also supplements the TRANSCO sulfur content data previously provided to the Bureau of Stationary Sources. The CPV Keasbey facility proposes to use either TRANSCO or TETCO gas supply.

The maximum daily sulfur content for either data is 0.55 grains/100 SCF, which is consistent with the maximum value of 0.63 grains/100 SCF used for the CPV Woodbridge facility permitting and for the emissions and performance data developed by GE for the CPV Keasbey 7HA.02 combustion turbine. The period average is about 0.2 grains/100 SCF. However, there are notable spikes in sulfur content throughout the period, namely the 0.63 grains/100 SCF presented in a prior set of data (provided to the Department), and at 0.55, 0.49, 0.385, and 0.372 in the current data sets. This demonstrates that spikes in sulfur content can and do occur within the gas supply and must be accounted for in the permitting process. As such, 0.63 is selected as the worst case sulfur content for short term sulfur dioxide emissions and for the combustion turbine performance. Note that while 0.63 grains S/100 SCF is the design basis sulfur content based on historical data, the actual natural gas sulfur content for gas to be supplied to the facility is wholly out of the control of CPV Keasbey.

The combustion turbine will also combust ULSD as a backup fuel. The emergency diesel engines will also burn ULSD. The ULSD is assumed to have a HHV of approximately 19,649 Btu/lb with a sulfur content of 15 ppm by weight.

The two (2) combustion turbines and auxiliary boiler at the existing Woodbridge Energy Center are permitted to burn natural gas exclusively while the emergency diesel engines are permitted to burn ULSD.

3.3 Operation

The combined cycle combustion turbine at the Keasbey Energy Center will be operated to follow electrical demand (i.e., dispatch mode), but will be designed and permitted to operate on a continuous basis. The combined cycle unit will not operate at steady-state below 30% load on natural gas and 50% load on ULSD. The Keasbey Energy Center will not operate the combustion turbine in simple cycle mode during normal operation. Additional equipment from the proposed Keasbey Energy Center that will be included in the air quality dispersion modeling analyses will include the emergency diesel generator, emergency diesel fire pump, auxiliary boiler, and wet mechanical draft cooling tower. The worst-case combustion turbine operating scenario for each pollutant and averaging period will be determined.

The combined cycle combustion turbines at the existing Woodbridge Energy Center are operated to follow electrical demand (i.e., dispatch mode) and are designed and permitted to operate on a continuous basis. The combined cycle units do not operate at steady-state below 50% load on natural gas. The existing Woodbridge Energy Center does not operate the combustion turbines in simple cycle mode. Additional equipment from the existing Woodbridge Energy Center that will be included in the air quality dispersion modeling analyses will include the emergency diesel generator (limited to 100 hours per year), emergency diesel fire pump (limited to 100 hours per year), auxiliary boiler (limited to 2,000 hours per year), and the 14-cell wet mechanical draft cooling tower. The worst-case combustion turbine operating scenario for each pollutant and averaging period will be determined.

The existing Woodbridge Energy Center and the proposed Keasbey Energy Center will be evaluated together since they can operate concurrently and their combined impacts will be compared to the Significant Impact Levels, PSD Class II increments, and NAAQS/NJAAQS.

3.4 Selection of Sources for Modeling

The emission source responsible for most of the potential emissions from the Keasbey project is the combustion turbine. This unit will be included in and is the main focus of the air quality modeling analyses. As discussed in Section 3.5, the modeling will include consideration of operation over a range of turbine loads and operating scenarios. Initial modeling of the turbine by itself will be conducted to identify those operating conditions for each pollutant and averaging period that yield the maximum modeled impacts. Any subsequent modeling incorporating other emissions units at the plant or other facilities will include the turbine operating conditions that yield the maximum modeled impacts. Modeling conducted for PM-10 and PM-2.5 for the combustion sources will include filterable and condensable PM. Modeling of PM-10 and PM-2.5 emissions from the cooling tower does not include condensable PM as there are no vaporous emissions which could condense to form particulate, with the exception of water vapor condensing to liquid water, which is not a regulated air contaminant.

Ancillary sources at Keasbey (the emergency diesel generator, emergency diesel fire pump, auxiliary boiler, and wet mechanical draft cooling tower) will also be included in the modeling analyses. The emergency equipment may operate for up to one hour per day for readiness testing and maintenance purposes. Operation of the emergency equipment for longer periods of time in an emergency mode would not be expected to occur when the turbine is operating.

According to NJDEP guidance found in the Technical Manual 1002: Guidance on Preparing an Air Quality Modeling Protocol (NJDEP, November 2009), the mechanical draft cooling towers at both Woodbridge and Keasbey will be included in the modeling analysis for PM-10/PM-2.5 standards compliance if the total PM-10/PM-2.5 emission rate from the towers are greater than 1.0 pound per hour. Since the total combined PM-10 emission rate from both towers is greater than 1.0 pound per hour, both cooling towers will be included in the modeling analysis for PM-10 standards compliance. Further, since the total combined PM-2.5 emission rate from both towers is also greater than 1.0 pound per hour, both cooling towers will be included in the modeling analysis for PM-2.5 standards compliance. Tables 3-3a and 3-3b present the exhaust parameters, particulate emission rates, and location coordinates for the wet mechanical draft cooling tower at Keasbey. Additionally, Tables 3-3c and 3-3d present the exhaust parameters, particulate emission rates, and location coordinates for the existing wet mechanical draft cooling tower at Woodbridge.

The air permit application will assume that the Process Water Supply will come from treated effluent from the Middlesex County Utilities Authority (MCUA) and will be the source of the cooling tower water. The particulate matter emissions from the cooling tower are calculated using AP-42 emission factors which includes the circulating water rate, quantity of liquid water drift and the concentration of total dissolved solids (TDS) within the circulating water. The TDS concentration is managed operationally using conductivity as a surrogate for TDS and by increasing or decreasing the cooling tower blowdown rate. This is controlled automatically based on the level set by the control room operator. Tower blowdown is a side-stream of the circulating water that is directed to the wastewater discharge. Increasing the blowdown rate will cause a decrease in the circulating water TDS concentration since a greater flow of lower TDS makeup water is added to the tower. While the makeup water has a fairly low TDS, it is not entirely constant and, as such, monitoring the circulating water TDS and controlling the blowdown rate provide a reliable method for maintaining a constant circulating water TDS.

In order to minimize makeup water flow, the circulating water TDS set point can be set high, which causes a lower blowdown rate. Conversely, in order to minimize tower drift particulate, the circulating water TDS can be set lower, causing the makeup water rate to be increased to a level that will balance the reduced particulate emissions. The tradeoff is with the operating cost of increased makeup water usage.

Since AP-42 does not account for PM-2.5 emissions, the total particulate matter emission rate is separated into PM-10 and PM-2.5 fractions using a droplet size distribution representative of a wet cooling tower using a high-efficiency drift eliminator. The droplet size distribution represents the total liquid drift from the tower, of which, when the droplets evaporate (assumed to be essentially immediately), will form total suspended particulate (TSP). The fractions of PM-10 and PM-2.5 were estimated using the calculation method posited by Reisman and Frisbie (Reisman, J., and Frisbie, G. 2002, Calculating Realistic PM10 Emissions from Cooling Towers, Abstract No. 216 presented at the 2001 94th Annual Air and Waste Management Association Conference and Exhibition in Orlando, Florida, June 25th to 28th). The particle size calculation methodology is based on the Reisman and Frisbie formulas. Note that this method of particulate matter fractionation is endorsed by many regulatory agencies and is included in certain agency air quality modeling guidance documents. As can be demonstrated in the worksheet, the PM-10 and PM-2.5 fractions are calculated using a linear interpolation of the evaporated drift droplet particulates. For reference purposes, the particle size calculation worksheet and the droplet size distribution for an industry standard high efficiency drift eliminator is included in Appendix A.

3.5 Exhaust Stack Configuration and Emission Parameters (Keasbey Energy Center)

The general arrangement site plan for the proposed facility is presented in Figure 3-1. Preliminary exhaust characteristics of the turbine/heat recovery steam generator stack during different operating scenarios are provided in Tables 3-1a and 3-1b. Exhaust parameters are presented for natural gas firing at four (4) ambient temperatures (-8 degrees Fahrenheit, 40 degrees Fahrenheit, 59 degrees Fahrenheit, and 105 degrees Fahrenheit), five loads (30%, 46%, 50%, 75%, and 100%), and operating conditions for HRSG duct firing. Exhaust parameters are also presented for ULSD firing at three ambient temperatures (-8 degrees Fahrenheit, 59 degrees Fahrenheit, and 105 degrees Fahrenheit) and three (3) loads (50%, 75%, and 100%). Table 3-2 presents the preliminary potential emission rates for each of the operating scenarios. In addition, emission rates and stack parameters are presented for evaporative cooling during natural gas and ULSD operation. Thus, emission rates and stack parameters for twenty-six (26) ambient temperatures and load combinations will be used to determine the "worst-case" operating scenario for the turbine. Note that per U.S. EPA PM-2.5 modeling guidance, the emissions of PM-2.5 should account for NO_2 and SO_2 precursor emissions (U.S. EPA, 2013). CPV Keasbey, LLC proposes to use a numerical screening approach suggested by the Northeast States for Coordinated Air Use Management (NESCAUM) in a May 30, 2013 comment letter to George Bridgers (Air Quality Modeling Group, U.S. EPA) responding to "Draft Guidance for PM-2.5 Permit Modeling" released by U.S. EPA on March 4, 2013. The approach calls for the use of a 7 percent per hour SO_2 to sulfate conversion rate and a 5 percent per hour NO_2 to nitrate conversion rate. The direct PM-2.5 emission rate is then increased accordingly by adding these incremental emissions. NESCAUM notes that it believes this method "would provide a conservative, definitive, and defensible value of the estimated contribution of secondary particulates". (NESCAUM, 2013) For reference purposes, this letter can be found in Appendix A.

The following calculations were used (per the aforementioned NESCAUM letter on page 6):

Secondary PM-2.5 from SO_2 = X lb/hr $SO_2 \cdot 0.07 \cdot 2.06$

Where: 2.06 = molecular weight of ammonium sulfate (132 g/mol) divided by the molecular weight of sulfur dioxide (64 g/mol)

Secondary PM-2.5 from NO_x = X lb/hr $NO_x \cdot 0.05 \cdot 0.8 \cdot 1.74$

Where: 1.74 = molecular weight of ammonium nitrate (80 g/mol) divided by the molecular weight of nitrogen dioxide (46 g/mol); and,

0.8 = application of the ambient ratio method (Tier 2) NO to NO_2 conversion rate to the NO_x emission rate.

<u>Combustion Turbine (Case #1 example calculation)</u>
Secondary PM-2.5 from SO_2 = 9.5 lb/hr $SO_2 \cdot 0.07 \cdot 2.06$ = 1.37 lb/hr
Secondary PM-2.5 from NO_x = 32.6 lb/hr $NO_x \cdot 0.05 \cdot 0.8 \cdot 1.74$ = 2.27 lb/hr
Primary PM-2.5 = 23.1 lb/hr
Total Primary PM-2.5 + Secondary PM-2.5 = 26.74 lb/hr

<u>Auxiliary Boiler</u>
Secondary PM-2.5 from SO_2 = 0.43 lb/hr $SO_2 \cdot 0.07 \cdot 2.06$ = 0.062 lb/hr
Secondary PM-2.5 from NO_x = 0.72 lb/hr $NO_x \cdot 0.05 \cdot 0.8 \cdot 1.74$ = 0.05 lb/hr
Primary PM-2.5 = 0.51 lb/hr
Total Primary PM-2.5 + Secondary PM-2.5 = 0.62 lb/hr

Emergency Diesel Fire Pump

Secondary PM-2.5 from SO_2 = 0.003 lb/hr SO_2 ▪ 0.07 ▪ 2.06 = 0.0004 lb/hr

Secondary PM-2.5 from NO_x = 1.81 lb/hr NO_x ▪ 0.05 ▪ 0.8 ▪ 1.74 = 0.13 lb/hr

Primary PM-2.5 = 0.08 lb/hr

Primary PM-2.5 + Secondary PM-2.5 = 0.21 lb/hr

Emergency Diesel Generator

Secondary PM-2.5 from SO_2 = 0.037 lb/hr SO_2 ▪ 0.07 ▪ 2.06 = 0.005 lb/hr

Secondary PM-2.5 from NO_x = 17.10 lb/hr NO_x ▪ 0.05 ▪ 0.8 ▪ 1.74 = 1.19 lb/hr

Primary PM-2.5 = 0.55 lb/hr

Primary PM-2.5 + Secondary PM-2.5 = 1.75 lb/hr

Finally, Tables 3-4 to 3-6 present the preliminary stack parameters and emission rates for the auxiliary boiler, emergency diesel fire pump, and emergency diesel generator, respectively. The emergency diesel generator and emergency diesel fire pump at Keasbey will not be included in the 1-hour SO_2 and 1-hour NO_2 modeling analyses, per the exemption as defined in the July 29, 2011 policy memorandum issued by NJDEP exempting emergency generator and fire pump NO_x and SO_2 emissions from 1-hour NO_2 and SO_2 air quality modeling at combined cycle turbine facilities. CPV has already agreed to the permit conditions contained in the aforementioned policy memorandum for the emergency diesel fire pump and emergency diesel generator at Woodbridge and proposes to agree to the same conditions for Keasbey. For reference purposes, this policy memorandum can be found in Appendix A. The emergency diesel generator and emergency diesel fire pump will be included in the modeling analyses for all other pollutants and averaging periods.

For the proposed emergency diesel generator and emergency diesel fire pump at the Keasbey Energy Center, CPV is proposing to operate each unit up to 100 hours per year, the same conditions that exist for the emergency diesel generator and emergency diesel fire pump at the Woodbridge Energy Center. The emergency diesel generator and emergency diesel fire pump are not expected to be tested more than once per week (with test durations expected to be limited by permit condition to no more than 30 minutes) and are not expected to contribute significantly to the annual distribution of maximum 1-hour concentrations.

3.5.1 Exhaust and Emission Parameters (Woodbridge Energy Center)

The equipment from the existing Woodbridge Energy Center that will be included in the air dispersion modeling demonstration will include the two (2) combustion turbines, the auxiliary boiler, the emergency diesel fire pump, the emergency diesel generator, and the 14-cell wet mechanical draft cooling tower. The coordinates of the Woodbridge emission units reflect their true "as-built" locations which are presented on Figure 3-1 Site Arrangement Plan. Exhaust characteristics of the turbine/heat recovery steam generator stacks during different operating scenarios are provided in Table 3-7. Exhaust parameters are presented for natural gas firing at three (3) ambient temperatures (-8 degrees Fahrenheit, 56 degrees Fahrenheit, and 105 degrees Fahrenheit), three (3) loads (50%, 75%, and 100%), and operating conditions for HRSG duct firing. Table 3-8 presents the preliminary potential emission rates for each of the operating scenarios. In addition, emission rates and stack parameters are presented for evaporative cooling during natural gas operation. Thus, emission rates and stack parameters for fourteen (14) ambient temperatures and load combinations will be used to determine the "worst-case" operating scenario for the turbines.

Table 3-3c provides exhaust parameters and particulate matter emission rates for the existing wet mechanical draft cooling tower. Exhaust parameters and emissions rates for the existing auxiliary boiler stack are provided in Table 3-9. Tables 3-10 and 3-11 provide exhaust parameters and emission rates for the existing emergency diesel fire pump and existing emergency diesel generator, respectively. Similar to Keasbey, the emergency diesel generator and emergency diesel fire pump at Woodbridge will not be included in the 1-hour SO_2 and 1-hour NO_2 modeling analyses, per the exemption as defined in the July 29, 2011 policy memorandum issued by NJDEP exempting emergency generator and fire pump NO_x and SO_2 emissions from 1-hour NO_2 and SO_2 air quality modeling at combined cycle turbine facilities. When the Woodbridge Energy Center was permitted, CPV agreed to the conditions contained in the aforementioned policy memorandum. The emergency diesel generator and emergency diesel fire pump will be included in the modeling analyses for all other pollutants and averaging periods.

The existing emergency diesel generator and emergency diesel fire pump at the Woodbridge Energy Center are each permitted to operate up to 100 hours per year. These permit conditions will remain the same. CPV has already agreed to the permit conditions contained in the aforementioned policy memorandum for the emergency diesel fire pump and emergency diesel generator. The emergency diesel generator and emergency diesel fire pump are not tested more than once per week (with test durations limited by permit condition to no more than 30 minutes) and are not expected to contribute significantly to the annual distribution of maximum 1-hour concentrations.

3.5.2 Combined Modeling of Keasbey Energy Center and Woodbridge Energy Center

While the proposed Keasbey Energy Center is being permitted as a major modification to the existing Woodbridge Energy Center, the two (2) facilities will be able to operate independently of each other. Any and all operating scenarios (normal operations and startups/shutdowns) at the proposed Keasbey Energy Center will be able to operate concurrently with any and all operating scenarios (normal operations and startups/shutdowns) at the existing Woodbridge Energy Center.

The modeled sources at the proposed Keasbey Energy Center will include one combustion turbine (firing natural gas and ULSD), one auxiliary boiler (firing natural gas), one emergency diesel fire pump (firing ULSD), one emergency diesel generator (firing ULSD), and a wet mechanical draft cooling tower (PM-10/PM-2.5 only).

The modeled sources at the existing Woodbridge Energy Center will include two combustion turbines (natural gas), one auxiliary boiler (natural gas), one emergency diesel fire pump (ULSD), one emergency diesel generator (ULSD), and a wet mechanical draft cooling tower (PM-10/PM-2.5 only).

All twenty-six (26) combustion turbine operating cases as listed in Table 3-2 will be modeled to determine which case is the "worst-case" operating scenario for each pollutant and averaging period for the proposed Keasbey Energy Center. All fourteen (14) combustion turbine operating cases as listed in Table 3-8 will be modeled to determine which case is the "worst-case" operating scenario for each pollutant and averaging period for the existing Woodbridge Energy Center. Source groups combining the combustion turbine operating cases for common ambient temperature conditions for Keasbey and Woodbridge will be used to determine the pollutant-specific "worst-case" for the combined facility emissions. The pollutant-specific "worst-case" operating scenario(s) determined from the Keasbey Energy Center load analysis coupled with the pollutant-specific "worst-case" operating scenarios determined from the Woodbridge Energy Center load analysis will be modeled concurrently with the other ancillary sources at both facilities for all pollutants and averaging periods, with the following exceptions:

- The emergency diesel generators and emergency diesel fire pumps at Keasbey and Woodbridge will not be included in the 1-hour SO_2 and 1-hour NO_2 modeling analyses, per the exemption as defined in the July 29, 2011 policy memorandum issued by NJDEP exempting emergency generator and fire pump NO_x and SO_2 emissions from 1-hour NO_2 and SO_2 air quality modeling at combined cycle turbine facilities. The emergency diesel generators and emergency diesel fire pumps will be included in the modeling analyses for all other pollutants and averaging periods.

  The existing emergency diesel generator and emergency diesel fire pump at the Woodbridge Energy Center are each permitted to operate up to 100 hours per year. These permit conditions will remain the same. For the proposed emergency diesel generator and emergency diesel fire pump at the Keasbey Energy Center, CPV is proposing to operate each unit up to 100 hours per year, the same conditions that exist for the emergency diesel generator and emergency diesel fire pump at the Woodbridge Energy Center. CPV has already agreed to the permit conditions contained in the aforementioned policy memorandum for the emergency diesel fire pump and emergency diesel generator at the existing Woodbridge Energy Center and proposes to agree to the same conditions for the emergency diesel generator and emergency diesel fire pump at the proposed Keasbey Energy Center.

The emergency diesel generators and emergency diesel fire pumps are not expected to be tested more than once per week (with test durations limited by permit condition to no more than 30 minutes) and are not expected to contribute significantly to the annual distribution of maximum 1-hour concentrations. Therefore, it is proposed that 1-hour NO_2 modeling will not include the emergency diesel generators and emergency diesel fire pumps.

- Since they are not combustion sources, the wet mechanical draft cooling towers at Keasbey and Woodbridge will only be modeled for PM-10/PM-2.5 emissions.

3.6 Good Engineering Practice (GEP) Stack Height

Section 123 of the Clean Air Act (CAA) Amendments required the United States Environmental Protection Agency (U.S. EPA) to promulgate regulations to assure that the degree of emission limitation for the control of any air pollutant under an applicable State Implementation Plan (SIP) was not affected by (1) stack heights that exceed Good Engineering Practice (GEP) or (2) any other dispersion technique. The U.S. EPA provides specific guidance for determining GEP stack height and for determining whether building downwash will occur in the Guidance for Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations), (EPA-450/4-80-023R, June, 1985). GEP is defined as "...the height necessary to ensure that emissions from the stack do not result in excessive concentrations of any air pollutant in the immediate vicinity of the source as a result of atmospheric downwash, eddies, and wakes that may be created by the source itself, nearby structures, or nearby terrain "obstacles"."

The GEP definition is based on the observed phenomenon of atmospheric flow in the immediate vicinity of a structure. It identifies the minimum stack height at which significant adverse aerodynamics (downwash) are avoided. The U.S. EPA GEP stack height regulations specify that the GEP stack height be calculated in the following manner:

$$H_{GEP} = H_B + 1.5L$$

Where: H_B = the height of adjacent or nearby structures, and
L = the lesser dimension (height or projected width of the adjacent or nearby structures).

A general arrangement site plan that shows the proposed Keasbey Energy Center and the existing Woodbridge Energy Center is shown in Figure 3-1. This general arrangement site plan fulfills the requirements set out in the Bureau's Technical Manual 1002. A GEP stack height analysis has been conducted using the U.S. EPA approved Building Profile Input Program with PRIME (BPIPPRM, version 04274). GEP analysis tables can be found in Tables 3-12 and 3-13. The controlling structure will be the HRSG at a height of 94 feet above grade, resulting in a formula GEP height of 235 feet above grade. Since a non-GEP stack is proposed, direction-specific downwash parameters for the combustion turbine exhaust stack will be determined using BPIPPRM, version 04274. Direction-specific downwash parameters for the additional Keasbey auxiliary equipment exhaust stacks to be modeled (i.e., auxiliary boiler, emergency equipment, and cooling tower) will also be determined using BPIPPRM, version 04274. Further, direction-specific downwash parameters for the two (2) existing combustion turbines, auxiliary boiler, emergency equipment, and cooling tower at Woodbridge Energy Center will also be determined using BPIPPRM, version 04274. Any direction-specific building downwash parameters will be input to the PSD modeling analysis.

Figure 3-1: General Arrangement Plan

Table 3-1a: Keasbey Energy Center Combustion Turbine/HRSG Source Parameters (Natural Gas Fired)

Operating Case	Fuel	Ambient Temperature (F)	Operating Load (%)	Duct Firing (On/Off)	Evaporative Cooler Operation (On/Off)	Modeling Stack Parameters		
						Exhaust Temperature (K)	Exhaust Velocity (m/s)[a]	Exhaust Flow (acfm)
Case1	Gas	-8	100	On	Off	335.37	22.23	1,663,088
Case2	Gas	-8	100	Off	Off	345.37	22.66	1,695,786
Case3	Gas	-8	75	Off	Off	342.59	17.98	1,345,657
Case4	Gas	-8	46	Off	Off	341.48	14.07	1,053,192
Case5	Gas	59	100	On	Off	337.04	21.93	1,640,987
Case6	Gas	59	100	Off	Off	345.93	22.29	1,667,946
Case7	Gas	59	75	Off	Off	341.48	17.14	1,282,564
Case8	Gas	59	30	Off	Off	337.59	11.05	827,022
Case9	Gas	105	100	On	On	339.26	21.04	1,574,584
Case10	Gas	105	100	Off	On	349.82	21.47	1,606,470
Case11	Gas	105	100	On	Off	337.04	19.20	1,436,816
Case12	Gas	105	100	Off	Off	347.59	19.58	1,464,813
Case13	Gas	105	75	Off	Off	345.93	16.10	1,205,008
Case14	Gas	105	50	Off	Off	344.82	13.26	992,066
Case15	Gas	-8	100	On	Off	343.71	22.58	1,689,282
Case16	Gas	59	100	On	On	337.59	22.31	1,669,789

[a]Based on a stack diameter of 22 feet.
UTM coordinates of proposed 160 foot above grade combustion turbine/HRSG stack are 557,515 meters Easting, 4,485,100 meters Northing, NAD83, Zone 18 at a base elevation of 22.5 feet above mean sea level.

<u>Sample Exhaust Velocity (m/s) Calculation: Case #1</u>
Exhaust Velocity (m/s) = (ft^3/min * min/sec * m^3/ft^3) / Pi * ((diameter^2)/4)
Exhaust Velocity (m/s) = (1,663,088 ft^3/min * 1 min/60 sec * 1 m^3/35.3145 ft^3) / Pi * ((6.7056 m^2)/4)
Exhaust Velocity = 22.23 m/s

Table 3-1b: Keasbey Energy Center Combustion Turbine/HRSG Source Parameters (ULSD Fired)

Operating Case	Fuel	Ambient Temperature (F)	Operating Load (%)	Duct Firing (On/Off)	Evaporative Cooler Operation (On/Off)	Modeling Stack Parameters		
						Exhaust Temperature (K)	Exhaust Velocity (m/s)[a]	Exhaust Flow (acfm)
Case17	ULSD	40	100	Off	Off	352.04	23.54	1,761,312
Case18	ULSD	-8	50	Off	Off	348.71	15.43	1,154,342
Case19	ULSD	59	100	Off	Off	354.26	23.59	1,765,195
Case20	ULSD	59	75	Off	Off	349.82	18.49	1,383,516
Case21	ULSD	59	50	Off	Off	343.71	14.17	1,060,287
Case22	ULSD	105	100	Off	On	359.82	22.59	1,690,496
Case23	ULSD	105	100	Off	Off	357.59	20.84	1,559,476
Case24	ULSD	105	50	Off	Off	345.37	12.57	940,780
Case25	ULSD	105	75	Off	Off	351.48	16.17	1,209,656
Case26	ULSD	-8	75	Off	Off	350.93	19.20	1,437,051

[a]Based on a stack diameter of 22 feet.
UTM coordinates of proposed 160 foot above grade combustion turbine/HRSG stack are 557,515 meters Easting, 4,485,100 meters Northing, NAD83, Zone 18 at a base elevation of 22.5 feet above mean sea level.

<u>Sample Exhaust Velocity (m/s) Calculation: Case #17</u>
Exhaust Velocity (m/s) = (ft^3/min * min/sec * m^3/ft^3) / Pi * ((diameter^2)/4)
Exhaust Velocity (m/s) = (1,761,312 ft^3/min * 1 min/60 sec * 1 m^3/35.3145 ft^3) / Pi * ((6.7056 m^2)/4)
Exhaust Velocity = 23.54 m/s

Table 3-2: Keasbey Energy Center Combustion Turbine/HRSG Emission Rates

Operating Case	Modeled Emission Rate (g/s)			
	NO_x	CO	PM-10/PM-2.5[a]	SO_2
Case1	4.11	2.51	2.91/3.37	1.20
Case2	3.33	2.03	1.76/2.14	0.97
Case3	2.65	1.61	1.65/1.95	0.77
Case4	1.90	1.16	1.52/1.74	0.55
Case5	4.03	2.46	2.86/3.31	1.17
Case6	3.28	1.99	1.75/2.12	0.96
Case7	2.56	1.55	1.63/1.91	0.75
Case8	1.42	0.87	1.44/1.60	0.42
Case9	3.87	2.36	2.87/3.30	1.13
Case10	3.09	1.88	1.73/2.07	0.90
Case11	3.80	2.31	2.98/3.40	1.11
Case12	2.82	1.71	1.68/1.99	0.82
Case13	2.23	1.36	1.58/1.82	0.65
Case14	1.70	1.04	1.49/1.68	0.50
Case15	3.41	2.08	2.78/3.17	0.99
Case16	4.13	2.52	2.92/3.38	1.21
Case17	7.27	2.21	8.19/8.82	0.86
Case18	4.31	1.31	7.99/8.36	0.51
Case19	7.21	2.19	8.19/8.81	0.85
Case20	5.57	1.70	8.08/8.56	0.66
Case21	4.23	1.29	7.99/8.36	0.50
Case22	6.60	2.00	8.15/8.72	0.78
Case23	6.11	1.85	8.11/8.64	0.72
Case24	3.70	1.13	7.95/8.27	0.44
Case25	4.83	1.47	8.03/8.44	0.57
Case26	5.68	1.73	8.09/8.58	0.67

[a]Filterable plus condensable, and applying NESCAUM, 2013 for secondary PM-2.5.

Table 3-3a: Keasbey Energy Center Cooling Tower Exhaust Characteristics and PM-10/PM-2.5 Emission Rates

Emissions Parameter	
Number of Cells (up to)	10
Maximum Total Air Flow Rate (acfm) (Each Cell)	1,448,000
Maximum Water Flow Rate (gpm) (Total Tower)	153,000
Maximum Drift Rate	0.0005%
Total Solids in Circulating Water (ppm)	6,240
10-cell Total TSP Emission Rate (lb/hr) (Total Tower)	2.39
1-cell TSP Emission Rate (g/s)	0.030
10-cell Total PM-10 Emission Rate (lb/hr) (Total Tower)	1.55
1-cell PM-10 Emission Rate (g/s)	0.020
10-cell Total PM-2.5 Emission Rate (lb/hr) (Total Tower)	0.58
1-cell PM-2.5 Emission Rate (g/s)	0.007
10-cell Total TSP Annual Emission Rate (ton/yr) (Total Tower)	10.46
10-cell Total PM-10 Annual Emission Rate (ton/yr) (Total Tower)	6.81
10-cell Total PM-2.5 Annual Emission Rate (ton/yr) (Total Tower)	2.56
Exhaust Parameter	
Exhaust Height (ft above grade)	54
Exhaust Height (m above grade)	16.46
Collar Height (ft above grade)	40
Collar Height (m above grade)	12.19
Exhaust Temperature (deg F)	80
Exhaust Velocity (ft/sec)	40.63
Exhaust Velocity (m/sec)	12.38
Inner Diameter (ft)	27.5
Inner Diameter (m)	8.38
Base elevation (ft)	22.5

Table 3-3b: Keasbey Energy Center Cooling Tower Cell Location Coordinates

Cooling Tower Cell #	UTM Easting, Zone 18, NAD83 (m)	UTM Northing, Zone 18, NAD83 (m)
1	557,510	4,485,061
2	557,527	4,485,064
3	557,543	4,485,067
4	557,559	4,485,071
5	557,575	4,485,074
6	557,514	4,485,045
7	557,530	4,485,049
8	557,546	4,485,052
9	557,562	4,485,056
10	557,578	44,85,059

Table 3-3c: Woodbridge Energy Center Cooling Tower Exhaust Characteristics and PM-10/PM-2.5 Emission Rates

Emissions Parameter	
Number of Cells	14
Maximum Total Air Flow Rate (acfm) (Each Cell)	1,341,000
Maximum Water Flow Rate (gpm) (Total Tower)	148,000
Maximum Drift Rate	0.0005%
Total Solids in Circulating Water (ppm)	6,240
14-cell Total TSP Emission Rate (lb/hr) (Total Tower)	2.31
1-cell TSP Emission Rate (g/s)	0.021
14-cell Total PM-10 Emission Rate (lb/hr) (Total Tower)	1.5
1-cell PM-10 Emission Rate (g/s)	0.014
14-cell Total PM-2.5 Emission Rate (lb/hr) (Total Tower)	0.56
1-cell PM-2.5 Emission Rate (g/s)	0.005
14-cell Total TSP Annual Emission Rate (ton/yr) (Total Tower)	10.12
14-cell Total PM-10 Annual Emission Rate (ton/yr) (Total Tower)	6.58
14-cell Total PM-2.5 Annual Emission Rate (ton/yr) (Total Tower)	2.43
Exhaust Parameter	
Exhaust Height (ft above grade)	55
Exhaust Height (m above grade)	16.76
Collar Height (ft above grade)	41.85
Collar Height (m above grade)	12.76
Exhaust Temperature (deg F)	85
Exhaust Velocity (ft/sec)	31.62
Exhaust Velocity (m/sec)	9.64
Inner Diameter (ft)	30
Inner Diameter (m)	9.14
Base elevation (ft)	19.5

Table 3-3d: Woodbridge Energy Center Cooling Tower Cell Location Coordinates

Cooling Tower Cell #	UTM Easting, Zone 18, NAD83 (m)	UTM Northing, Zone 18, NAD83 (m)
1	557,650	4,485,094
2	557,665	4,485,097
3	557,679	4,485,100
4	557,693	4,485,103
5	557,708	4,485,107
6	557,722	4,485,110
7	557,736	4,485,113
8	557,653	4,485,082
9	557,667	4,485,085
10	557,682	4,485,088
11	557,696	4,485,091
12	557,710	4,485,094
13	557,725	4,485,097
14	557,739	4,485,100

Table 3-4: Keasbey Energy Center Auxiliary Boiler Exhaust Characteristics and Emissions

Emission Parameter	
Pollutant	**lb/hr**
NO_x	0.72
CO	2.68
PM-10/PM-2.5[a]	0.51/0.62
SO_2	0.43
Exhaust Parameter	
Exhaust Height (ft above grade)	40
Exhaust Height (m above grade)	12.19
Exhaust Temperature (deg F)	300
Exhaust Flow (acfm)	22,250
Exhaust Velocity (ft/sec)	52.46
Exhaust Velocity (m/sec)	15.99
Inner Diameter (ft)	3
Inner Diameter (m)	0.91
Stack Base Elevation (ft)	22.5
UTM Easting (m), NAD83, Zone 18	557,541
UTM Northing (m), NAD83, Zone 18	4,485,141

[a]Filterable plus condensable, and applying NESCAUM, 2013 for secondary PM-2.5.

Table 3-5: Keasbey Energy Center Emergency Diesel Fire Pump Exhaust Characteristics and Emissions

Emission Parameter	
Pollutant	**lb/hr**
NO_x	1.81
CO	0.95
PM-10/PM-2.5[a]	0.08/0.21
SO_2	0.003
Exhaust Parameter	
Exhaust Height (ft above grade)	26
Exhaust Height (m above grade)	7.92
Exhaust Temperature (deg F)	1,076
Exhaust Flow (acfm)	1,900
Exhaust Velocity (ft/sec)	90.72
Exhaust Velocity (m/sec)	27.65
Inner Diameter (ft)	0.67
Inner Diameter (m)	0.20
Stack Base Elevation (ft)	22.5
UTM Easting (m), NAD83, Zone 18	557,482
UTM Northing (m), NAD83, Zone 18	4,485,119

[a]Filterable plus condensable, and applying NESCAUM, 2013 for secondary PM-2.5.

Table 3-6: Keasbey Energy Center Emergency Diesel Generator Exhaust Characteristics and Emissions

Emission Parameter	
Pollutant	**lb/hr**
NO_x	17.10
CO	9.64
PM-10/PM-2.5[a]	0.55/1.75
SO_2	0.037
Exhaust Parameter	
Exhaust Height (ft above grade)	20
Exhaust Height (m above grade)	6.10
Exhaust Temperature (deg F)	759
Exhaust Flow (acfm)	10,908.7
Exhaust Velocity (ft/sec)	231.49
Exhaust Velocity (m/sec)	70.56
Inner Diameter (ft)	1
Inner Diameter (m)	0.30
Stack Base Elevation (ft)	22.5
UTM Easting (m), NAD83, Zone 18	557,564
UTM Northing (m), NAD83, Zone 18	4,485,151

[a]Filterable plus condensable, and applying NESCAUM, 2013 for secondary PM-2.5.

Table 3-7: Woodbridge Energy Center Combustion Turbine/HRSG Source Parameters

Operating Case	Fuel	Ambient Temperature (F)	Operating Load (%)	Duct Firing (On/Off)	Evaporative Cooler Operation (On/Off)	Modeling Stack Parameters		
						Exhaust Temperature (K)	Exhaust Velocity (m/s)[a]	Exhaust Flow (acfm)
Case1	Gas	-8	100	Off	Off	360.2	20.00	1,237,051
Case2	Gas	-8	100	On	Off	353.0	19.74	1,220,716
Case3	Gas	-8	75	Off	Off	353.9	15.93	985,177
Case4	Gas	-8	50	Off	Off	346.5	12.47	771,092
Case5	Gas	56	100	Off	Off	357.6	18.30	1,131,842
Case6	Gas	56	100	On	Off	351.4	18.12	1,120,712
Case7	Gas	59	100	On	Off	351.4	18.03	1,115,284
Case8	Gas	56	75	Off	Off	349.4	14.17	876,317
Case9	Gas	59	50	Off	Off	345.5	11.85	732,549
Case10	Gas	105	100	Off	On	362.4	17.94	1,109,399
Case11	Gas	105	100	On	On	357.6	17.77	1,098,857
Case12	Gas	105	100	On	On	356.0	17.77	1,099,012
Case13	Gas	105	75	Off	Off	352.8	13.50	834,647
Case14	Gas	105	50	Off	Off	351.0	12.19	753,867

[a]Based on a stack diameter of 20 feet.
UTM coordinates of two (2) 145 foot combustion turbine stacks are 557,683 meters Easting, 4,485,153 meters Northing, and 557,722 meters Easting, 4,485,161 meters Northing, NAD83, Zone 18 at a base elevation of 19.5 feet above mean sea level.

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Table 3-8: Woodbridge Energy Center Combustion Turbine/HRSG Emission Rates

Operating Case	Modeled Emission Rate (g/s) – per turbine			
	NO_x	CO	PM-10/PM-2.5[a]	SO_2
Case1	2.12	1.29	1.52/1.60	0.52
Case2	2.49	1.51	2.12/2.20	0.60
Case3	1.68	1.02	1.45/1.51	0.42
Case4	1.34	0.82	1.39/1.43	0.33
Case5	1.92	1.17	1.49/1.55	0.47
Case6	2.29	1.40	2.08/2.16	0.55
Case7	2.31	1.41	2.41/2.49	0.57
Case8	1.55	0.95	1.42/1.48	0.38
Case9	1.22	0.74	1.36/1.40	0.30
Case10	1.81	1.11	1.47/1.54	0.44
Case11	2.02	1.22	1.76/1.83	0.49
Case12	2.23	1.36	2.39/2.47	0.54
Case13	1.41	0.86	1.40/1.45	0.34
Case14	1.17	0.72	1.35/1.39	0.29

[a]Filterable plus condensable, and applying NESCAUM, 2013 for secondary PM-2.5.

Table 3-9: Woodbridge Energy Center Auxiliary Boiler Exhaust Characteristics and Emissions

Emission Parameter	
Pollutant	**lb/hr**
NO_x	0.92
CO	3.44
PM-10/PM-2.5[a]	0.46/0.55
SO_2	0.16
Exhaust Parameter	
Exhaust Height (ft above grade)	40
Exhaust Height (m above grade)	12.19
Exhaust Temperature (deg F)	310
Exhaust Velocity (ft/sec)	57.3
Exhaust Velocity (m/sec)	17.5
Inner Diameter (ft)	3.3
Inner Diameter (m)	0.99
Stack Base Elevation (ft)	19.5
UTM Easting (m), NAD83, Zone 18	557,636
UTM Northing (m), NAD83, Zone 18	4,485,176

[a]Filterable plus condensable, and applying NESCAUM, 2013 for secondary PM-2.5.

Table 3-10: Woodbridge Energy Center Emergency Diesel Fire Pump Exhaust Characteristics and Emissions

Emission Parameter	
Pollutant	**lb/hr**
NO_x	1.93
CO	1.81
PM-10/PM-2.5[a]	0.10/0.23
SO_2	0.003
Exhaust Parameter	
Exhaust Height (ft above grade)	20
Exhaust Height (m above grade)	6.10
Exhaust Temperature (deg F)	961
Exhaust Velocity (ft/sec)	171.1
Exhaust Velocity (m/sec)	52.2
Inner Diameter (ft)	0.4
Inner Diameter (m)	0.13
Stack Base Elevation (ft)	19.5
UTM Easting (m), NAD83, Zone 18	557,604
UTM Northing (m), NAD83, Zone 18	4,485,216

[a]Filterable plus condensable, and applying NESCAUM, 2013 for secondary PM-2.5.

Table 3-11: Woodbridge Energy Center Emergency Diesel Generator Exhaust Characteristics and Emissions

Emission Parameter	
Pollutant	**lb/hr**
NO_x	21.16
CO	1.99
PM-10/PM-2.5[a]	0.13/1.66
SO_2	0.0208
Exhaust Parameter	
Exhaust Height (ft above grade)	30
Exhaust Height (m above grade)	9.14
Exhaust Temperature (deg F)	763.5
Exhaust Velocity (ft/sec)	528.1
Exhaust Velocity (m/sec)	161.0
Inner Diameter (ft)	0.7
Inner Diameter (m)	0.20
Stack Base Elevation (ft)	19.5
UTM Easting (m), NAD83, Zone 18	557,679
UTM Northing (m), NAD83, Zone 18	4,485,227

[a]Filterable plus condensable, and applying NESCAUM, 2013 for secondary PM-2.5.

Table 3-12: Keasbey GEP Analysis

Structure	Facility	Structure Height (ft)	Max Projected Width (ft)	5L Region of Influence Distance (ft)	Calculated GEP Stack Height (ft)	Distance to Keasbey Turbine Stack (ft)
Demin Water Tank	Keasbey	40.0	50.0	200.0	100.0	361.3
Cooling Tower Cell 01	Keasbey	54.0	28.0	140.0	96.0	201.1
Cooling Tower Cell 02	Keasbey	54.0	28.0	140.0	96.0	234.4
Cooling Tower Cell 03	Keasbey	54.0	28.0	140.0	96.0	160.4
Cooling Tower Cell 04	Keasbey	54.0	28.0	140.0	96.0	174.5
Cooling Tower Cell 05	Keasbey	54.0	28.0	140.0	96.0	200.4
Cooling Tower Cell 06	Keasbey	54.0	28.0	140.0	96.0	163.3
Cooling Tower Cell 07	Keasbey	54.0	28.0	140.0	96.0	128.5
Cooling Tower Cell 08	Keasbey	54.0	28.0	140.0	96.0	112.8
Cooling Tower Cell 09	Keasbey	54.0	28.0	140.0	96.0	118.4
Cooling Tower Cell 10	Keasbey	54.0	28.0	140.0	96.0	167.4
Cooling Tower Building	Keasbey	40.0	290.0	200.0	100.0	99.0
Oil Tank	Keasbey	50.0	65.0	250.0	125.0	143.4
Combustion Turbine Bld	Keasbey	31.0	73.0	155.0	77.5	157.0
HRSG Tier 01	Keasbey	64.5	52.0	260.0	142.5	117.0
HRSG Tier 02	Keasbey	94.0	110.0	470.0	235.0	12.0
Steam Turbine Bld	Keasbey	46.0	129.0	230.0	115.0	238.0
Air Inlet Filter	Keasbey	44.0	66.0	220.0	110.0	214.0
Raw Water Tank	Keasbey	60.0	67.0	300.0	150.0	76.6
Combustion Turbine 01 Tier 01	Woodbridge	30.0	60.0	149.9	75.0	593.0
HRSG 01 Tier 01	Woodbridge	49.0	73.0	245.0	122.5	567.0
HRSG 01 Tier 02	Woodbridge	95.0	87.0	435.0	225.5	547.0
Combustion Turbine 01 Tier 02	Woodbridge	30.0	44.0	149.9	75.0	609.0
Air Inlet Filter 01	Woodbridge	81.8	56.0	280.0	165.8	621.0
Combustion Turbine 02 Tier 01	Woodbridge	30.0	60.0	149.9	75.0	718.0
HRSG 02 Tier 01	Woodbridge	49.0	73.0	245.0	122.5	695.0
HRSG 02 Tier 02	Woodbridge	95.0	87.0	435.0	225.5	677.0
Combustion Turbine 02 Tier 02	Woodbridge	30.0	44.0	149.9	75.0	732.0
Air Inlet Filter 02	Woodbridge	81.8	56.0	280.0	165.8	741.0
Steam Turbine Building	Woodbridge	44.0	121.0	220.0	110.0	476.0
Warehouse Building	Woodbridge	25.0	177.0	125.0	62.5	276.0
Demin Water Tank	Woodbridge	24.2	40.0	120.9	60.4	445.8
Cooling Tower Building	Woodbridge	41.9	351.0	209.3	104.7	413.0
Cooling Tower Cell 01	Woodbridge	55.0	30.0	150.0	100.0	710.2
Cooling Tower Cell 02	Woodbridge	55.0	30.0	150.0	100.0	718.3
Cooling Tower Cell 03	Woodbridge	55.0	30.0	150.0	100.0	663.2
Cooling Tower Cell 04	Woodbridge	55.0	30.0	150.0	100.0	671.7
Cooling Tower Cell 05	Woodbridge	55.0	30.0	150.0	100.0	616.3
Cooling Tower Cell 06	Woodbridge	55.0	30.0	150.0	100.0	625.3
Cooling Tower Cell 07	Woodbridge	55.0	30.0	150.0	100.0	569.2
Cooling Tower Cell 08	Woodbridge	55.0	30.0	150.0	100.0	579.2
Cooling Tower Cell 09	Woodbridge	55.0	30.0	150.0	100.0	522.7
Cooling Tower Cell 10	Woodbridge	55.0	30.0	150.0	100.0	533.3
Cooling Tower Cell 11	Woodbridge	55.0	30.0	150.0	100.0	476.0
Cooling Tower Cell 12	Woodbridge	55.0	30.0	150.0	100.0	487.4
Cooling Tower Cell 13	Woodbridge	55.0	30.0	150.0	100.0	429.8
Cooling Tower Cell 14	Woodbridge	55.0	30.0	150.0	100.0	442.4

Table 3-13: Woodbridge GEP Analysis

Structure	Facility	Structure Height (ft)	Max Projected Width (ft)	5L Region of Influence Distance (ft)	Calculated GEP Stack Height (ft)	Distance to Woodbridge Turbine 01 Stack (ft)	Distance to Woodbridge Turbine 02 Stack (ft)
Demin Water Tank	Keasbey	40.0	50.0	200.0	100.0	382.0	493.5
Cooling Tower Cell 01	Keasbey	54.0	28.0	140.0	96.0	425.7	547.0
Cooling Tower Cell 02	Keasbey	54.0	28.0	140.0	96.0	450.0	566.4
Cooling Tower Cell 03	Keasbey	54.0	28.0	140.0	96.0	475.3	598.3
Cooling Tower Cell 04	Keasbey	54.0	28.0	140.0	96.0	544.9	665.5
Cooling Tower Cell 05	Keasbey	54.0	28.0	140.0	96.0	496.6	615.3
Cooling Tower Cell 06	Keasbey	54.0	28.0	140.0	96.0	594.9	717.0
Cooling Tower Cell 07	Keasbey	54.0	28.0	140.0	96.0	525.8	650.0
Cooling Tower Cell 08	Keasbey	54.0	28.0	140.0	96.0	577.3	702.5
Cooling Tower Cell 09	Keasbey	54.0	28.0	140.0	96.0	628.6	754.6
Cooling Tower Cell 10	Keasbey	54.0	28.0	140.0	96.0	644.7	768.0
Cooling Tower Building	Keasbey	40.0	290.0	200.0	100.0	405.0	527.0
Oil Tank	Keasbey	50.0	65.0	250.0	125.0	654.8	784.6
Combustion Turbine Bld	Keasbey	31.0	73.0	155.0	77.5	569.0	698.0
HRSG Tier 01	Keasbey	64.5	52.0	260.0	142.5	559.0	690.0
HRSG Tier 02	Keasbey	94.0	110.0	470.0	235.0	556.0	688.0
Steam Turbine Bld	Keasbey	46.0	129.0	230.0	115.0	583.0	709.0
Air Inlet Filter	Keasbey	44.0	66.0	220.0	110.0	500.0	626.0
Raw Water Tank	Keasbey	60.0	67.0	300.0	150.0	649.6	780.1
Combustion Turbine 01 Tier 01	Woodbridge	30.0	60.0	149.9	75.0	143.0	183.0
HRSG 01 Tier 01	Woodbridge	49.0	73.0	245.0	122.5	79.0	132.0
HRSG 01 Tier 02	Woodbridge	95.0	87.0	435.0	225.5	18.0	99.0
Combustion Turbine 01 Tier 02	Woodbridge	30.0	44.0	149.9	75.0	197.0	226.0
Air Inlet Filter 01	Woodbridge	81.8	56.0	280.0	165.8	226.0	251.0
Combustion Turbine 02 Tier 01	Woodbridge	30.0	60.0	149.9	75.0	183.0	143.0
HRSG 02 Tier 01	Woodbridge	49.0	73.0	245.0	122.5	132.0	79.0
HRSG 02 Tier 02	Woodbridge	95.0	87.0	435.0	225.5	99.0	18.0
Combustion Turbine 02 Tier 02	Woodbridge	30.0	44.0	149.9	75.0	226.0	197.0
Air Inlet Filter 02	Woodbridge	81.8	56.0	280.0	165.8	251.0	226.0
Steam Turbine Building	Woodbridge	44.0	121.0	220.0	110.0	217.0	306.0
Warehouse Building	Woodbridge	25.0	177.0	125.0	62.5	164.0	294.0
Demin Water Tank	Woodbridge	24.2	40.0	120.9	60.4	114.8	240.0
Cooling Tower Building	Woodbridge	41.9	351.0	209.3	104.7	140.0	140.0
Cooling Tower Cell 01	Woodbridge	55.0	30.0	150.0	100.0	203.9	151.9
Cooling Tower Cell 02	Woodbridge	55.0	30.0	150.0	100.0	237.6	193.6
Cooling Tower Cell 03	Woodbridge	55.0	30.0	150.0	100.0	176.8	155.5
Cooling Tower Cell 04	Woodbridge	55.0	30.0	150.0	100.0	214.5	196.7
Cooling Tower Cell 05	Woodbridge	55.0	30.0	150.0	100.0	159.1	172.5
Cooling Tower Cell 06	Woodbridge	55.0	30.0	150.0	100.0	200.0	210.6
Cooling Tower Cell 07	Woodbridge	55.0	30.0	150.0	100.0	153.3	198.5
Cooling Tower Cell 08	Woodbridge	55.0	30.0	150.0	100.0	195.3	232.7
Cooling Tower Cell 09	Woodbridge	55.0	30.0	150.0	100.0	160.8	231.3
Cooling Tower Cell 10	Woodbridge	55.0	30.0	150.0	100.0	201.2	261.3
Cooling Tower Cell 11	Woodbridge	55.0	30.0	150.0	100.0	180.3	268.6
Cooling Tower Cell 12	Woodbridge	55.0	30.0	150.0	100.0	217.6	295.4
Cooling Tower Cell 13	Woodbridge	55.0	30.0	150.0	100.0	208.4	308.5
Cooling Tower Cell 14	Woodbridge	55.0	30.0	150.0	100.0	241.4	331.8

4.0 REGULATORY REQUIREMENTS

Air quality modeling requirements are specified under Federal U.S. EPA and NJDEP regulatory programs including PSD and non-attainment NSR programs, and the State of New Jersey Administrative Code, Title 7, Chapter 27, Subchapter 8 (N.J.A.C. 7:27-8) for preconstruction permits and minor source operating permits, and N.J.A.C. 7:27-22 for major source operating permits. All applicable requirements that include air quality impact assessments are outlined in this section.

4.1 New Source Review

The Federal New Source Review (NSR) program consists of the non-attainment NSR and PSD programs. Applicability of these programs to the proposed facility is determined based upon the attainment status and the potential emissions of the proposed facility. New Jersey's non-attainment NSR for NO_x and VOC requires the use of lowest achievable emission rate (LAER) controls and compliance with emission offset requirements should facility emissions exceed applicable thresholds. PSD requires the application of Best Available Control Technology (BACT).

4.1.1 Attainment Status

The U.S. EPA has established National Ambient Air Quality Standards (NAAQS) for each of the following criteria air pollutants: PM-10, PM-2.5, sulfur dioxide (SO_2), ozone (O_3), nitrogen dioxide (NO_2), carbon monoxide (CO), and lead (Pb). Areas in which the NAAQS are being met are referred to as attainment areas. Areas in which the NAAQS are not being met are referred to as non-attainment areas. Areas that were formerly non-attainment areas but are now in attainment and covered by a maintenance plan are referred to as maintenance areas. Areas for which sufficient data are not available to determine a classification are referred to as unclassifiable. The federal attainment status designations of areas in New Jersey with respect to NAAQS are listed at 40 CFR 81.331. The project is located in Middlesex County in the New Jersey-New York-Connecticut Air Quality Control Region (AQCR).

The location of the Keasbey Energy Center facility is in an area currently designated as attainment for SO_2, NO_2, CO, PM-10, and PM-2.5. Middlesex County, however, is designated as marginal non-attainment for the 2008 8-hour ozone ambient air quality standard. Under the marginal non-attainment designation for 8-hour ozone, new sources with emissions of NO_x exceeding 25 tons per year and/or emissions of VOC exceeding 25 tons per year are subject to non-attainment new source review (NSR), require the application of LAER control technology, and must obtain NO_x and/or VOC offsets. The applicability of LAER and emission offsets in New

Jersey is set forth in N.J.A.C. 7:27-18. Potential net emission increases of 25 tons per year or greater of NO_x and/or VOC emissions trigger Subchapter 18 applicability.

4.1.2 Prevention of Significant Deterioration

The New Jersey Administrative Code adopted the PSD program pursuant to 40 CFR 52.21, which is administered through the NJDEP permitting process, and applies to a new or modified major facility located in an attainment area. The Department accepted an updated delegation of the administration of the PSD program from the U.S. EPA on July 15, 2011. As such, any fossil fuel fired steam electric plant with a heat input capacity greater than 250 mmBTU/hr and potential emissions greater than 100 tons per year of any regulated pollutant is considered a "major" source and is subject to the PSD regulations. The existing Woodbridge Energy Center is an existing major PSD source. The addition of the Keasbey Energy Center constitutes a major modification because criteria pollutant increases will exceed the PSD Significant Emission Rates (SERs) as shown in Table 4-1. As such, the Keasbey Energy Center will be subject to PSD review.

Facilities subject to PSD must perform an air quality analysis (which includes atmospheric dispersion modeling) and a best available control technology (BACT) demonstration for those pollutants that exceed the pollutant specific Significant Emission Rates (SERs) identified in the regulations. These emission rates, as well as the non-attainment NSR thresholds, are provided in Table 4-1. (Note that since NO_x and VOC are precursors to ozone formation, NO_x and VOC emissions will be controlled to the more stringent LAER emission levels if they exceed the non-attainment NSR thresholds).

Dispersion modeling for the PSD requirements consists of three analyses: a significance analysis, a NAAQS/NJAAQS analysis, and a PSD increment analysis. The significance analysis compares the maximum-modeled ambient concentrations from the proposed and existing facilities to the significant impact levels (SILs) listed in Table 4-2c for each pollutant. The NAAQS/NJAAQS analysis compares the maximum-modeled ambient concentrations from the proposed and existing facilities, plus the ambient background, to the NAAQS listed in Table 4-2a and the NJAAQS in Table 4-3. The PSD increment analysis will demonstrate that the Keasbey Energy Center and Woodbridge Energy Center will be in compliance with the Class I and Class II PSD increments established for SO_2, NO_2, and PM-10/PM-2.5 presented in Tables 4-2d and 4-2b. The NAAQS are listed in Table 4-2a, the PSD Class II increments are listed in Table 4-2b, the Class I SILs and PSD Class I increments are listed in Table 4-2d, and the NJAAQS are listed in Table 4-3.

4.1.3 Preconstruction Ambient Air Quality Monitoring Exemption

As discussed previously, PSD regulations require an applicant to perform an air quality analysis for those pollutants emitted in quantities exceeding the SERs shown in Table 4-1. This analysis can include the collection of up to one year of preconstruction ambient air quality monitoring data. Preliminary facility emissions indicate that air quality monitoring could be required for some of the pollutants listed in Table 4-1.

Pursuant to the PSD regulations codified in 40 CFR 52.21, U.S. EPA may exempt a proposed PSD source, otherwise subject to the one-year pre-construction ambient monitoring requirement, if existing quality assured ambient air quality data are available from alternate locations that are representative of conditions at the proposed facility location.

TRC, on behalf of CPV Keasbey, LLC, prepared and submitted a preconstruction monitoring exemption request to the NJDEP for its review on July 12, 2016. A copy of this request is included in Appendix A. U.S. EPA Region II provided comments on this request on July 26, 2016. A copy of these comments is also included in Appendix A. The applicant will provide a response to the U.S. EPA Regions II's July 26, 2016 comments on the July 12, 2016 preconstruction ambient monitoring waiver request under a separate cover.

4.2 New Jersey Department of Environmental Protection Regulations

Applicable regulations from Chapter 7:27 of the New Jersey Administrative Code are identified below:

- Subchapter 3 "Control and Prohibition of Smoke from Combustion of Fuel" - N.J.A.C. 7:27 - 3.5 limits the opacity from internal combustion engines and stationary combustion turbines to less than 20% opacity, exclusive of condensed water vapor for a period of more than 10 consecutive seconds. The natural gas and ULSD fired combustion turbine will normally have opacity near zero and are not expected to exceed even 10% for 10 consecutive seconds.

- Subchapter 4 "Control and Prohibition of Particles Combustion of Fuel" - N.J.A.C. 7:27 - 4.2(a) limits the mass emission of particulates from the proposed combined cycle unit, the auxiliary boiler, the emergency diesel generator, and the emergency diesel fire pump.

- Subchapter 8 "Permits and Certificates" - requires a pre-construction permit to be obtained for the proposed Keasbey Energy Center since the total heat input is greater than 1,000,000 Btu/hr and imposes State of the Art (SOTA) requirements for new and/or modified sources.

- Subchapter 9 "Sulfur in Fuels" - This subchapter does not limit the sulfur content of gaseous fuels; only liquid and solid fuel sulfur content limits are prescribed. Subchapter 9 limits the sulfur content of diesel fuel to 15 ppmw from July 1, 2016 and onward. Thus, the facility will use 15 ppm ultra-low sulfur diesel for any fuel oil fired combustion equipment (i.e., the combustion turbine, emergency diesel generator, and emergency diesel fire pump) planned to be installed at the Keasbey Energy Center.

- Subchapter 13 "Ambient Air Quality Standards" - The air quality impacts from the proposed Keasbey Energy Center should not exceed the standards presented in this subchapter.

- Subchapter 16 "Control and Prohibition of Air Pollution by Volatile Organic Compounds" - N.J.A.C. 7:27-16.9 establishes VOC and CO limits of 50 ppm and 250 ppm respectively for stationary gas turbines. The proposed limits will be well below these values for all load and fuel cases.

- Subchapter 18 "Control and Prohibition of Air Pollution from New or Altered Sources Affecting Ambient Air Quality (Emission Offset Rules)" - Establishes emission offsets and LAER requirements for defined major stationary sources.

- Subchapter 19 "Control and Prohibition of Air Pollution from Oxides of Nitrogen" - Limits NO_x emissions based upon equipment sizes and types.

- Subchapter 22 "Operating Permits" – The facility will file for or obtain an operating permit within twelve months after commencing operation.

Table 4-1: Emission Rates, PSD Significant Emission Rates, and Non-attainment NSR Major Source Thresholds

Pollutant	Keasbey Energy Center Emission Rate[d] (tons per year)	Woodbridge Energy Center Emission Rate[d] (tons per year)	Keasbey Energy Center plus Woodbridge Energy Center Combined Emission Rate (tons per year)	PSD Significant Emission Rate (tons per year)	Non-attainment NSR Major Source Threshold (tons per year)
Carbon Monoxide	111.6	291.8	403.4	100	NA
Sulfur Dioxide	40.8	11.3	52.0	40	NA
Particulate Matter (PM)	72.0	53.7	125.7	25	NA
Particulate Matter less than 10 microns (PM-10)	122.5	99.1	221.6	15	NA
Particulate Matter less than 2.5 microns (PM-2.5)	118.3	94.9	213.2	10	NA
Nitrogen Oxides	151.9	147.9	299.9	40	25[a,b]
Ozone (VOC)	50.6	33.4	84.0	40	25[a,b]
Greenhouse Gases (GHG)	2,431,403	2,231,586	4,662,989	75,000	NA
Lead	0.03	0.005	0.03	0.6	10[c]
Fluorides	NA	NA	NA	3	NA
Sulfuric Acid Mist	25.7	7.7	33.4	7	NA
Hydrogen Sulfide	NA	NA	NA	10	NA
Total Reduced Sulfur (including H_2S)	NA	NA	NA	10	NA
Reduced Sulfur Compounds (including H_2S)	NA	NA	NA	10	NA

Note: Pursuant to 40 CFR 52.21 (b) (23) (i).
[a]Per N.J.A.C 7:27-18.
[b]As precursors to ozone.
[c]Considered to be lead compounds and a HAP, subject to the 10 ton per year major HAP source threshold.
[d]Includes all equipment.

Table 4-2a: National Ambient Air Quality Standards

Pollutant	Averaging Period	NAAQS[a] ($\mu g/m^3$)
Carbon Monoxide (CO)	1-Hour 8-Hour	40,000 10,000
Nitrogen Dioxide (NO_2)	1-Hour Annual	188[e] 100
Ozone (VOC)	8-Hour	137.2[b]
Inhalable Particulate Matter (PM-10)	24-Hour Annual	150[c] --
Fine Particulate Matter (PM-2.5)	24-Hour Annual	35[d] 12[g]
Sulfur Dioxide (SO_2)	1-Hour 24-Hour Annual 3-Hour	196[f] --[i] --[i] 1,300
Lead (Pb)	3-Month	0.15[h]

Note: (--) indicates there are no standards for this pollutant.
[a]All short-term (1-hr, 3-hr, 8-hr, and 24-hr) standards except ozone, PM-2.5, PM-10, and 1-hour SO_2 and NO_2 are not to be exceeded more than once per year. Therefore, conservatively, the modeled concentration is the highest concentration. No exceedances are allowed for annual standards. Therefore, the modeled concentrations is the highest concentration.
[b]For 8-hr ozone, EPA uses the average of the annual 4th highest 8-hour daily maximum concentrations from each of the last three years of air quality monitoring data to determine a violation of the standard.
[c]Modeled concentration is the highest 6th highest concentration over 5-years of meteorological data.
[d]Modeled concentration is the 98th percentile of the 5-year averages of the maximum modeled 24-hour average PM-2.5 concentrations (EPA memorandum, dated March 20, 2014, from S. Page, "Guidance for PM-2.5 Permit Modeling"). It should be noted that the design value for the 24-hour averaging period is based on the 3-year average of the annual 98th percentile.
[e]Modeled concentration is the 98th percentile (H8H) of the annual distribution of daily maximum 1-hour concentrations averaged across 5-years of meteorological data (EPA memorandum, dated June 28, 2010, from T. Fox, "Applicability of Appendix W Modeling Guidance for the 1-hour NO_2 NAAQS".
[f]Modeled concentration is the 99th percentile of the annual distribution of daily maximum 1-hour concentrations averaged across 5-years of meteorological data (EPA memorandum dated August 23, 2010, from S. Page, "Guidance Concerning the Implementation of the 1-hour SO_2 NAAQS for the PSD Program").
[g]Modeled concentration is the highest average of the modeled annual averages across 5-years of meteorological data.
[h]Modeled concentration will be conservatively estimated from the maximum 24-hour concentration.
[i]Modeled concentrations will be compared to the SILs and NJAAQS.

Table 4-2b: PSD Class II Increments

Pollutant	Averaging Period	Class II PSD Increment ($\mu g/m^3$)
Carbon Monoxide (CO)	1-Hour 8-Hour	-- --
Nitrogen Dioxide (NO_2)	1-Hour Annual	-- 25[b]
Ozone (VOC)	8-Hour	--
Inhalable Particulate Matter (PM-10)	24-Hour Annual	30[a] 17[b]
Fine Particulate Matter (PM-2.5)	24-Hour Annual	9[a] 4[b]
Sulfur Dioxide (SO_2)	1-Hour 24-Hour Annual 3-Hour	-- 91[a] 20[b] 512[a]
Lead (Pb)	3-Month	--

Note: (--) indicates there are no standards for this pollutant.
[a]One exceedance allowed per year. Therefore, the modeled concentration is the highest second-highest concentration.
[b]No exceedances are allowed for annual averages. Therefore, the modeled concentration is the highest concentration.

Table 4-2c: Significant Impact Levels

Pollutant	Averaging Period	Significant Impact Level ($\mu g/m^3$)
Carbon Monoxide (CO)	1-Hour 8-Hour	2,000[a] 500[a]
Nitrogen Dioxide (NO_2)	1-Hour Annual	7.5[b] 1[a]
Ozone (VOC)	8-Hour	1.96[f]
Inhalable Particulate Matter (PM-10)	24-Hour Annual	5[a] 1[a]
Fine Particulate Matter (PM-2.5)	24-Hour Annual	1.2[d] 0.3[e]
Sulfur Dioxide (SO_2)	1-Hour 24-Hour Annual 3-Hour	7.8[c] 5[a] 1[a] 25[a]
Lead (Pb)	3-Month	--

Note: (--) indicates there are no standards for this pollutant.
[a]The modeled concentration is the highest concentration.
[b]Proposed SIL of 7.5 ug/m³ per June 29, 2010 memorandum "Guidance concerning the Implementation of the 1-Hour NO_2 NAAQS for the PSD Program" from U.S. EPA. Therefore, the modeled concentration is the highest of the 5-year averages of the maximum modeled concentrations at each receptor, based on 5-years of meteorological data.
[c]Interim SIL of 3 ppb (7.8 ug/m³) per August 23, 2010 memorandum "Guidance Concerning the Implementation of the 1-hour SO_2 NAAQS for the Prevention of Significant Deterioration Program" from Steven Page (Director of U.S. EPA OAQPS). Therefore, the modeled concentration is the highest of the 5-year averages of the maximum modeled concentrations at each receptor, based on 5-years of meteorological data.
[d]The modeled concentration is the highest of the 5-year averages of the maximum modeled 24-hour average PM-2.5 concentrations predicted each year at each receptor, based on 5-years of meteorological data (EPA memorandum, dated March 20, 2014, from S. Page, "Guidance for PM-2.5 Permit Modeling").
[e]The modeled concentration is the highest average of the modeled annual averages across 5-years of meteorological data (EPA memorandum, dated March 20, 2014, from S. Page, "Guidance for PM-2.5 Permit Modeling").
[f]U.S. EPA's proposed 8-hour ozone SIL was proposed on August 18, 2016.

Table 4-2d: Class I Significant Impact Levels and Class I PSD Increments

Pollutant	Averaging Period	Class I Significant Impact Concentration (µg/m3)	Class I PSD Increment (ug/m3)
SO_2	3-Hour	1.0	25
	24-Hour	0.2	5
	Annual	0.1	2
PM-2.5	24-Hour	0.07 (0.27)[a]	2
	Annual	0.06	1
PM-10	24-Hour	0.3	8
	Annual	0.2	4
NO_2	Annual	0.1	2.5

[a]A revised 24-hour PM-2.5 Class I SIL of 0.27 ug/m3 was proposed on August 18, 2016.

Notes:
U.S. EPA's proposed Class I SILs for NO_2, PM-10, and SO_2 were published in the July 23, 1996, Federal Register (61 FR 38249).
U.S. EPA's PM-2.5 Class I SILs codified in 40 CFR 52.21(k)(2) were vacated.
U.S. EPA's proposed Option 3 PM-2.5 Class I SILs were published in the September 21, 2007, Federal Register (72 FR 54112).

Table 4-3: New Jersey Ambient Air Quality Standards

Pollutant	Standard	Averaging Period	NJAAQS[a] (ug/m³)
Sulfur Dioxide	Primary Primary Secondary Secondary Secondary	12-month arith. mean 24-hour average 12-month arith. mean 24-hour average 3-hour average	80 365 60 260 1,300
Total Suspended Particulates	Primary Primary Secondary Secondary	12-month geom. mean 24-hour average 12-month geom. mean[b] 24-hour average	75 260 60 150
Carbon Monoxide	Primary & Secondary Primary & Secondary	8-hour average 1-hour average	10,000 40,000
Ozone[c]	Primary Secondary	Max. daily 1-hour average 1-hour average	235 160
Nitrogen Dioxide	Primary & Secondary NJDEP Guideline	12-month arith. mean 1-hour average	100 470
Lead	Primary & Secondary	Rolling 3-month average	1.5

[a]New Jersey short-term standards are not to be exceeded more than once in any 12 month period. Long-term standards are never to be exceeded.
[b]Intended as a guideline for achieving short-term standard.
[c]Maximum daily 1-hour average: averaged over a three year period, the expected number of days above the standard must be less than or equal to 1.

5.0 MODELING METHODOLOGY

Air quality dispersion modeling will be performed consistent with the procedures found in the following documents: Guideline on Air Quality Models (Revised) (U.S. EPA, 2017), New Source Review Workshop Manual (U.S. EPA, 1990), Screening Procedures for Estimating the Air Quality Impact of Stationary Sources (U.S. EPA, 1992), and Guidance on Preparing an Air Quality Modeling Protocol - Technical Manual 1002 (NJDEP, 2009).

5.1 Model Selection

The U.S. EPA has compiled a set of preferred, alternative, screening, and photochemical computer models for the calculation of pollutant impacts. The selection of a model depends on the characteristics of the source, as well as the nature of the surrounding study area. Of the four classes of models available, the Gaussian type model is the most widely used technique for estimating the impacts of nonreactive pollutants.

The U.S. EPA AERMOD model is proposed to be used. The AERMOD model was designed for assessing pollutant concentrations from a wide variety of sources (point, area, and volume). AERMOD is currently recommended for modeling studies in rural or urban areas, flat or complex terrain, and transport distances less than 50 kilometers, with one hour to annual averaging times.

AERMOD (version 16216r with PRIME) will be used for the preliminary modeling of the proposed facility's potential emissions to determine the maximum ambient air concentrations. The regulatory default option will be used in the dispersion modeling analysis performed for this project.

5.2 Surrounding Area and Land Use

A land cover classification analysis was performed to determine whether the urban source modeling option in AERMOD should be used in quantifying ground-level concentrations. The urban option in AERMOD accounts for the effects of increased surface heating on pollutant dispersion under stable atmospheric conditions. Essentially, the urban convective boundary layer forms in the night when stable rural air flows onto a warmer urban surface. The urban surface is warmer than the rural surface because the urban surface cools at a slower rate than the rural surface when the sun sets.

The USGS map (see Figure 5-1a) covering the area within a 3-kilometer radius of the site as well as the full modeling domain (20 kilometers by 20 kilometers) was reviewed and indicated that the majority of the surrounding area includes water, wooded areas, parks, and non-densely packed structures.

Additionally, the "AERMOD Implementation Guide" published on October 19, 2007 cautions users against applying the Land Use Procedure on a source-by-source basis and instead consider the potential for urban heat island influences across the full modeling domain. This approach is consistent with the fact that the urban heat island is not a localized effect, but is more regional in character.

Because the urban heat island is more of a regional effect, the Urban Source option in AERMOD will not be utilized since the area within 3 kilometers of the proposed site as well as the full modeling domain is not located in the New York City metropolitan area and thus, would not be subject to the New York City metropolitan area heat island.

The rural determination is further supported in an area coverage analysis of the United States Geological Survey (USGS) National Land Cover Dataset for 2011 (NLCD2011) (see Figure 5-1b). The percentages of each land use type (according to the Auer Land Use Classification Method) is as follows:

- I1/I2/C1 (Heavy Industrial/Light-moderate Industrial/Commercial): 16% (urban)
- R1 (Common Residential, low intensity): 19% (rural)
- R2/R3 (Compact Residential, high intensity): 25% (urban)
- R4/A1 (Estate Residential/Metropolitan Natural): 9% (rural)
- A3 (Undeveloped/Uncultivated/Wasteland): 15% (rural)
- A4 (Undeveloped/Rural): 4% (rural)
- A5 (Water Surfaces/Rivers/Lakes: 11% (rural)

Further, categories 23 (Developed, Medium Intensity) and 24 (Developed, High Intensity) are 25% and 16%, respectively, of the 3-kilometer radius area, for a total of 41% urban, with the remaining 59% classified as rural.

5.3 Meteorological Data

For any PSD modeling analysis conducted using the AERMOD model, two meteorological datasets are required: 1) hourly surface data and 2) upper air sounding data. According to the Guideline on Air Quality Models (Revised) (2017), the meteorological data used in a PSD modeling analysis should be selected based on its spatial and climatological representativeness of a proposed facility site and its ability to accurately characterize the transport and dispersion conditions in the area of concern. The spatial and climatological representativeness of the meteorological data are dependent on four factors:

1. The proximity of the meteorological monitoring site to the area under consideration;
2. The complexity of the terrain;
3. The exposure of the meteorological monitoring site; and,
4. The period of time during which data were collected.

This protocol presents one hourly surface dataset and one upper air sounding dataset for use in modeling the proposed facility to be located in the Township of Woodbridge, Middlesex County. Each of these meteorological datasets was reviewed using the U.S. EPA criteria. The nearest National Weather Service (NWS) operated meteorological monitoring station to the proposed facility site is at the Newark Liberty International Airport (WBAN 14734) in Essex County. The airport is located approximately 22 km north-northeast of the proposed facility site at an elevation of approximately 7 feet above MSL. Figure 5-2 shows the location of the Newark Liberty International Airport in relation to the proposed facility site. The meteorological monitoring station at the Airport continues to operate.

Both the proposed facility site and Newark Liberty International Airport are located within the same metropolitan, industrial area along the New Jersey/New York urban corridor. Further, there are no high ridges (i.e., intervening terrain) between the proposed facility site and the airport.

An Automated Surface Observing System (ASOS) station was installed at Newark Liberty International Airport on July 1, 1996 and data collected after this date was measured at a height of 32.8 feet. NJDEP has provided an AERMOD-ready Newark Liberty International Airport meteorological dataset (2010 – 2014) that will be used in the air quality modeling analysis.

A wind rose displaying the composite wind rose for all five years (2010 – 2014) of wind speed and direction for the Newark Liberty International Airport is shown in Figure 5-3. Over the five (5) year period, predominant winds varied from the northwest to the southwest. The average wind speed over the five years is 4.39 meters per second. Calm winds during the five years had an average frequency of calms of 0.61 percent. Additionally, the wind data recorded at the airport is reasonably consistent from year to year.

Thus, based on the information provided above, the applicant believes that the meteorological data recorded at the Newark Liberty International Airport are representative of the air regime at the proposed facility site and suitable to be used in the atmospheric dispersion modeling study for the Keasbey Energy Center because:

- Due to the proximity of the airport to the proposed facility site and the lack of significant intervening terrain features, overall climatological conditions would be expected to be quite similar at both the airport and the proposed facility site;

- The elevation of the airport (approximately 7 feet above MSL) and the proposed facility site elevation (approximately 20 feet above MSL) are comparable;
- The meteorological tower at the Newark Liberty International Airport is well sited and in an area free of obstructions to wind flow; and,
- The quality of the available data is good, exceeding U.S. EPA data recovery guidelines and displaying consistency from year to year of the available data record.

Concurrent upper air sounding data from Brookhaven National Labs, New York (WBAN 94703) was used with the hourly surface data from Newark Liberty International Airport by NJDEP to create the meteorological dataset required for the modeling analysis. Brookhaven National Labs is approximately 127 km to the east of the proposed facility site. Based on Holzworth's Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution Throughout the Contiguous United States, it is believed that upper air meteorological conditions in the Brookhaven, New York area are more representative than those from the next most proximate upper air station (Aberdeen Proving Ground, Maryland).

Further, comparing nearby surface temperature climatology (1981-2010 normals) from near the Brookhaven National Labs site (Shirley Brookhaven Airport, NY US, GHCND:USW00054790) and near the proposed facility site (New Brunswick 3 SE, NJ US, GHCND:USC00286055), one can note an average temperature difference of 1.50 F. Performing the same comparison with the local temperature near the proposed facility (the New Brunswick station) to a temperature observing station near the next proximate upper air station (Aberdeen Phillips Field, MD US, GHCND:USW00013701), there is an average temperature difference of 2.10 F. Thus, the Brookhaven location has more comparable local conditions than the next most proximate upper air station. Finally, given the latitudinal proximity of the proposed facility site to the Brookhaven upper air station (40.50N and 40.80N, respectively), it is likely that the vertical profile described by the Brookhaven upper air soundings more closely matches the vertical profile at the proposed facility site as both locations are dominated by marine boundary layer dynamics and likely experience similar marine stratocumulus shields and marine boundary layer depths at roughly the same periods. In contrast, the next most proximate upper air station (Aberdeen) would likely experience channeled and drainage flows via Chesapeake Bay and different marine boundary layer dynamics than those over the proposed facility site. Thus, the Brookhaven upper air site is considered more representative than the next most proximate upper air station.

Both the surface and upper air sounding data were processed by NJDEP using AERMOD's meteorological processor, AERMET (version 16216) and were provided to the applicant on February 15, 2017 for use on this project. The output from AERMET will be used as the meteorological database for the air quality modeling analysis and will consist of a surface data file and a vertical profile data file.

5.4 Sources

The proposed facility (Keasbey Energy Center) and existing Woodbridge Energy Center consist of various types of emission sources. The AERMOD technical manual will be used to set up the various sources to develop a logical and comprehensive modeling assessment. The following identifies the types of sources and how they will be assessed.

- Combustion Turbine Exhaust Stacks – Single point sources
- Ancillary Equipment Exhaust Stacks – Single point sources

5.5 Load Analysis

The proposed Keasbey Energy Center's combustion turbine will be operated over a range of loads. Preliminary exhaust characteristics of the turbine/heat recovery steam generator stack during different operating scenarios are provided in Tables 3-1a and 3-1b. Exhaust parameters are presented for natural gas firing at four (4) ambient temperatures (-8 degrees Fahrenheit, 40 degrees Fahrenheit, 59 degrees Fahrenheit, and 105 degrees Fahrenheit), five loads (30%, 46%, 50%, 75%, and 100%), and operating conditions for HRSG duct firing. Exhaust parameters are also presented for ULSD firing at three ambient temperatures (-8 degrees Fahrenheit, 59 degrees Fahrenheit, and 105 degrees Fahrenheit) and three (3) loads (50%, 75%, and 100%). Table 3-2 presents the preliminary potential emission rates for each of the operating scenarios. In addition, emission rates and stack parameters are presented for evaporative cooling during natural gas and ULSD operation. All twenty-six (26) combustion turbine operating cases as listed in Table 3-2 will be modeled to determine which case is the "worst-case" operating scenario for each pollutant and averaging period for the proposed Keasbey Energy Center.

The existing Woodbridge Energy Center's combustion turbines operate over a range of loads. Exhaust characteristics of the turbine/heat recovery steam generator stacks during different operating scenarios are provided in Table 3-7. Exhaust parameters are presented for natural gas firing at three (3) ambient temperatures (-8 degrees Fahrenheit, 56 degrees Fahrenheit, and 105 degrees Fahrenheit), three (3) loads (50%, 75%, and 100%), and operating conditions for HRSG duct firing and evaporative cooling. All fourteen (14) combustion turbine operating cases as listed in Table 3-8 will be modeled to determine which case is the "worst-case" operating scenario for each pollutant and averaging period for the existing Woodbridge Energy Center.

The load analysis to determine the worst-case combined concentrations from all operating loads will be performed using a matrix based on the operating cases by ambient temperature. The emission sources at each energy center will be modeled as a load screening analysis, with source groups combining the Keasbey and Woodbridge energy center sources for common operating temperatures. Summary tables identifying the worst-case concentrations will be presented for each energy center sources, individually and collectively.

The pollutant-specific "worst-case" operating scenario(s) determined from the Keasbey Energy Center significance modeling analysis coupled with the pollutant-specific "worst-case" operating scenarios determined from the Woodbridge Energy Center significance modeling analysis will be used in all subsequent modeling, including any PSD increment and multiple source NAAQS/NJAAQS analyses, including additional facility sources and potentially offsite sources.

5.6 Startups/Shutdowns (Keasbey Energy Center)

Startup is a short-term, transitional mode of operation for the combined cycle unit. In combined cycle operation, where the exhaust gases are directed through a HRSG to produce steam for a steam turbine generator, additional startup time is necessary in order to reduce thermal shock and excessive wear in both the HRSG and the steam turbine. Emission rates of some pollutants may be higher during startup operations because emissions controls may not become fully effective until a minimum threshold operating load and/or control device temperature is attained. The need for additional modeling to account for predicted short-term project impacts during startup of the combined cycle unit will be assessed for criteria pollutants for which a short-term NAAQS or PSD increment has been defined. Furthermore, in order to facilitate startup of the CTG and steam turbine generator, as well as for maintenance purposes, the auxiliary boiler will be modeled as operating simultaneously with the combustion turbine using the emissions and stack parameters detailed in Table 3-4.

For the proposed Keasbey Energy Center, startups are defined as cold, warm, and hot. The GE 7HA.02 combustion turbine can startup in a rapid response mode, which takes less time than a conventional start. The basic approach for rapid response mode is to thermodynamically decouple the gas turbine from the bottoming cycle, thereby allowing the gas turbine to start without the hold times needed to allow the HRSG and steam turbine to heat up. In other words, the rapid response start allows the plant to startup significantly faster than a conventional combined cycle plant by decoupling the steam turbine as the gas turbine ramps up and comes online.

The facility will require "cold starts," which are typically based on one startup after 72 hours or more of shutdown, "warm starts" (based on 8 hours to 72 hours of shutdown), and "hot starts" (based on 8 hours or less of shutdown). A cold gas-fired rapid start requires 45 minutes, a warm gas-fired rapid start requires 40 minutes, and a hot gas-fired rapid start requires 20 minutes. The combustion turbine also requires a 12 minute shutdown period. A cold ULSD-fired rapid start requires 45 minutes, a warm gas-fired rapid start requires 40 minutes, and a hot gas-fired rapid start requires 20 minutes. The combustion turbine also requires a 7 minute shutdown period.

Startup emissions and associated stack parameters for the natural gas and ULSD rapid response scenarios for the proposed Keasbey Energy Center have been estimated based on vendor data and are shown in Tables 5-1 and 5-2, respectively.

During the operational year, CPV Keasbey, LLC is proposing 10 cold gas fired rapid starts, 52 warm gas fired rapid starts, and 200 hot gas fired rapid starts. Only warm and hot gas fired rapid starts are proposed to be evaluated for 1-hour NO_2 since the number of cold gas fired rapid starts (10) can be deemed to occur infrequently (i.e., transient events). Cold, warm, and hot natural gas fired rapid starts will be evaluated for 1-hour and 8-hour CO.

CPV Keasbey, LLC is also proposing ten (10) ULSD fired rapid starts. ULSD fired rapid starts are not proposed to be evaluated for 1-hour NO_2 since the number of each (10) can be deemed to be transient events. Cold, warm, and hot ULSD fired rapid starts will be evaluated for 1-hour and 8-hour CO.

Because the startup/shutdown durations will be shorter than the averaging periods modeled, the modeled concentrations for these averaging periods that extend beyond the start-up duration will be determined based on the combination of the startup conditions for the appropriate amount of time and the worst case pollutant and averaging period specific operating scenario determined in the combustion turbine load analysis.

Unlike NO_x, CO, and VOC emissions which result from atypical combustion during the transient operating conditions that occur during the combustion turbine start and which are typically higher than during normal operation, the SO_2 emissions are only due to the quantity of sulfur compounds in the fuel, and the amount of fuel combusted during the start. Since the fuel flow is lower during a start than during normal (or continuous) operation, the SO_2 emissions will likewise be lower and would be less than the emissions during the minimum operating load. While SO_2 emissions are strictly dependent upon fuel flow (and lower during startup than continuous operation as discussed in the previous paragraph) and would generally not be proposed to be modeled, at the Department's request, SO_2 emissions during all startup and shutdown types are proposed to be modeled for the 1-hour and 3-hour averaging periods. For annual averaging periods, start-ups will only be included in the modeling analysis if the potential to emit for the facility increases due to the inclusion of start-ups into the annual potential to emit calculation.

5.6.1 Startups/Shutdowns (Woodbridge Energy Center)

For the existing Woodbridge Energy Center, startups are defined in the permit as "the period of time from initiation of combustion turbine operation until it achieves steady-state emissions compliance, less than or equal to 3.4 hours". Further, shutdowns are defined in the permit as "the period of time from initiation of lowering combustion turbine power output with the intent to cease generation of electrical output and concludes with the cessation of the combustion turbine operation, less than or equal to 30 minutes".

Permitted startup and shutdown emissions and associated stack parameters for the existing Woodbridge Energy Center are shown in Table 5-3.

Because the shutdown duration is shorter than the averaging periods modeled, the modeled concentrations for these averaging periods that extend beyond the start-up duration were determined based on the combination of the shutdown conditions for the appropriate amount of time and the worst-case pollutant-and averaging period-specific operating scenario determined in the combustion turbine load analysis (for CO and NO_2).

While SO_2 emissions are strictly dependent upon fuel flow (and lower during startup than continuous operation as discussed in the previous paragraph) and would generally not be proposed to be modeled, at the Department's request, SO_2 emissions during startups and shutdowns are proposed to be modeled for the 1-hour and 3-hour averaging periods.

In summary, the permitted startup/shutdown emissions for CO and NO_x were modeled since these pollutants have significantly higher emissions during startup and shutdown conditions when compared to normal operation for short-term averaging periods.

5.6.2 Combined Startups/Shutdowns (Keasbey Energy Center and Woodbridge Energy Center)

During the operational year, CPV Keasbey, LLC is proposing 10 cold gas fired rapid starts, 52 warm gas fired rapid starts, and 200 hot gas fired rapid starts. CPV Keasbey, LLC is also proposing ten (10) ULSD fired rapid starts. Woodbridge Energy Center's existing permit does not place limits on the number or types of startups and shutdowns that can occur.

For the purposes of this modeling analysis, the following is proposed to evaluate the combined startups and shutdowns at Keasbey and Woodbridge:

- 1-hour and 8-hour CO (natural gas at Keasbey and Woodbridge): Cold, warm, and hot natural gas fired startups and shutdowns at Keasbey and the permitted startups and shutdowns at Woodbridge;
- 1-hour and 8-hour CO (ULSD at Keasbey and natural gas at Woodbridge): Cold, warm, and hot ULSD fired startups and shutdowns at Keasbey and the permitted startups and shutdowns at Woodbridge;

- 1-hour NO_2 (natural gas at Keasbey and Woodbridge): warm and hot natural gas fired startups and shutdowns at Keasbey and the permitted startups and shutdowns at Woodbridge;
- 1-hour SO_2 (natural gas at Keasbey and Woodbridge): Cold, warm, and hot natural gas fired startups and shutdowns at Keasbey and Woodbridge;
- 1-hour SO_2 (ULSD at Keasbey and natural gas at Woodbridge): Cold, warm, and hot ULSD fired startups and shutdowns at Keasbey and startups and shutdowns at Woodbridge;
- 3-hour SO_2 (natural gas at Keasbey and Woodbridge): Cold, warm, and hot natural gas fired startups and shutdowns at Keasbey and Woodbridge; and,
- 3-hour SO_2 (ULSD at Keasbey and natural gas at Woodbridge): Cold, warm, and hot ULSD fired startups and shutdowns at Keasbey and startups and shutdowns at Woodbridge;

ULSD fired rapid starts at Keasbey are not proposed to be evaluated for 1-hour NO_2 since the number of USLD start events (10) and number of start hours (less than 7) can be deemed to be transient events. Cold, warm, and hot ULSD fired rapid starts and shutdowns will be evaluated for 1-hour and 8-hour CO and 1-hour and 3-hour SO_2.

5.7 1-Hour NO_2 Modeling

The air quality modeling analysis for the 1-hour NO_2 NAAQS will be performed consistent with the guidance and procedures established in the recently published and revised "Guideline on Air Quality Models" (January 17, 2017), the September 30, 2014 guidance memorandum titled "Clarification on the Use of AERMOD Dispersion Modeling for Demonstrating Compliance with the NO_2 NAAQS", and the March 1, 2011 guidance memorandum from Tyler Fox (EPA OAQPS) titled "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-Hour NO_2 NAAQS" (Memorandums). Based upon the discussion in the memorandums regarding the treatment of intermittent sources, it is proposed that only equipment or operating scenarios that "are continuous or frequent enough to contribute significantly to the annual distribution of daily maximum 1-hour concentrations" will be included in the 1-hour NO_2 modeling analysis.

This methodology, per the examples provided in the Memorandums, would exempt any facility equipment or operating scenarios from 1-hour NO_2 compliance modeling that does not operate on a normal daily or routine schedule. For example, the emergency diesel generators and emergency diesel fire pumps are not expected to be tested more than once per week (with test durations limited by permit condition to no more than 30 minutes) and are not expected to contribute significantly to the annual distribution of maximum 1-hour concentrations. For these reasons, and consistent with the Memorandums, it is proposed that 1-hour NO_2 modeling will not include the emergency diesel generators and emergency diesel fire pumps.

Further, the emergency diesel generators and emergency diesel fire pumps at both Woodbridge and Keasbey will not be included in the 1-hour SO_2 and 1-hour NO_2 modeling analyses, per the exemption as defined in the July 29, 2011 policy memorandum issued by NJDEP exempting emergency generator and fire pump NO_x and SO_2 emissions from 1-hour NO_2 and SO_2 air quality modeling at combined cycle turbine facilities. CPV has already agreed to the permit conditions contained in the aforementioned July 29, 2011 policy memorandum for the emergency diesel fire pump and emergency diesel generator at the existing Woodbridge Energy Center and proposes to agree to the same conditions for the Keasbey Energy Center. It should be noted that these permit conditions do not allow for the simultaneous testing of emergency generators and/or fire pumps and limit the durations of the test operations to no more than 30 minutes. Readiness testing of emergency equipment generally occurs approximately once per week.

The other combustion sources at Woodbridge (combustion turbines and auxiliary boiler) and Keasbey (combustion turbine and auxiliary boiler) will be included in the 1-hour NO_2 modeling analyses.

NO_2 emissions during a gas fired cold startup of the Keasbey combustion turbine will occur only for a limited number of events (10). Further, NO_2 emissions during ULSD startups of the Keasbey combustion turbine will also occur only for a limited number of events (10). According to the previously mentioned EPA guidance (September 30, 2014 and March 1, 2011 guidance memorandums, respectively), intermittent operations such as startup scenarios are to be treated differently. The guidance recommends that "...compliance demonstrations for the 1-hour NO_2 NAAQS can be limited to those emissions that are continuous enough or frequent enough to contribute significantly to the annual distribution of daily maximum 1-hour concentrations". The combustion turbine startups (cold starts on gas and ULSD starts) are not relatively continuous. The guidance memorandums also reference the example of "a large base-load power plant that may experience startup/shutdown events on a relatively infrequent basis...may be appropriate to consider under this guidance". It is clear from the EPA guidance memorandum that intermittent scenarios such as cold startups on gas and ULSD startups should not be treated in the same way that normal continuous scenarios are treated. The applicant believes that the cold gas and ULSD startup scenarios for the combustion turbine should qualify for treatment under the intermittent source guidance by not including these scenarios in the 1-hour NO_2 modeling analyses.

As previously discussed, startup and shutdown conditions that are expected to contribute to the annual distribution of daily maximum concentrations due to their frequency on a yearly basis will be included in the air quality modeling analysis for the 1-hour NO_2 standard.

The following tiered screening options will be applied for the various analyses per the guidance specified in the recently finalized "Revisions to the Guideline on Air Quality Models: Enhancements to the AERMOD Dispersion Modeling System and Incorporation of Approaches to Address Ozone and Fine Particulate Matter", published final in the Federal Register on January 17, 2017, and the U.S. EPA Memorandum "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard" section entitled Approval and Application of Tiering Approach for NO_2 (found on pages 5 through 8 of the memorandum). The applicant proposes to use the Tier 2 screening approach for initial modeling results using the Ambient Ratio Method 2 (ARM2), which provides estimates of representative equilibrium ratios of NO_2/NO_x values based on ambient levels of NO_2 and NO_x derived from national data from the EPA's Air Quality System. The national default for ARM2 is proposed to be used, and includes a minimum ambient NO_2/NO_x ratio of 0.5 and maximum ambient NO_2/NO_x ratio of 0.9. This method will be applied to both the SIL and NAAQS/increment analyses, respectively for the 1-hour and annual averages. Note that the applicant may also propose the use of the Tier 3 screening approach applying PVMRM should the Tier 2 method prove too conservative. Should the applicant decide to propose this approach, approval for the use of Tier 3 will be requested from U.S. EPA Region 2. This method will be employed if the modeled Tier 2 concentration plus a representative background concentration exceeds the NAAQS.

5.8 NJDEP Air Toxics Risk Analysis

The receptor-point concentrations of any toxic substance identified by NJDEP as a Hazardous Air Pollutant (HAP) that could potentially be emitted from the proposed Keasbey Energy Center and the existing Woodbridge Energy Center will be assessed in order to evaluate the potential health risk to the public beyond the property line of the proposed facility. This will be done by considering each individual HAP emission that contributes to the evaluation as well as by considering the cumulative effects of the HAPs that contribute to the evaluation.

To assess the potential for offsite public health threats, the NJDEP Technical Manual 1003: Guidance on Preparing a Risk Assessment Protocol for Air Contaminant Emissions will be used. The NJDEP has prescribed and provided an Air Toxics Risk Screening Worksheet to ascertain the potential health effects from facilities seeking permits to emit air toxics. TRC proposes to model (using AERMOD) the 24-hour and annual concentrations from those HAPs which are above the Subchapter 22 reporting threshold emission rates. The combined concentrations from Keasbey and Woodbridge will be evaluated against the reference concentrations found in the NJDEP Risk Technical Manual 1003 and risk screening worksheet.

The HAPs and emission rates that will be evaluated in the risk assessment will be included in the PSD permit application that will be submitted to the NJDEP. It should be noted that although sulfuric acid mist is not listed as a HAP under the Clean Air Act, it is included in NJDEP's Risk Screening Worksheet. Further, in the case of lead, the rolling 3-month period maximum will be conservatively estimated from the 24-hour concentration.

5.9 Receptor Grid

5.9.1 Basic Grid

The AERMOD model requires receptor data consisting of location coordinates and ground-level elevations. The receptor generating program, AERMAP (Version 11103), will be used to develop a complete receptor grid to a distance of 10 kilometers from the proposed facility. AERMAP uses digital elevation model (DEM) or the National Elevation Dataset (NED) data obtained from the USGS. The preferred elevation dataset based on NED data will be used in AERMAP to process the receptor grid. This is currently the preferred data to be used with AERMAP as indicated in the U.S. EPA AERMOD Implementation Guide (U.S. EPA, 2009). AERMAP will be run to determine the representative elevation for each receptor using 1/3 arc second NED files that will be obtained for an area covering at least 20 kilometers in all directions from the facility. The NED data will be obtained through the Multi-Resolution Land Characteristics Consortium (MRLC) link at http://www.mrlc.gov/viewerjs/.

The following rectangular (i.e. Cartesian) receptors will be used to assess the air quality impact of the proposed facility:

- Fine grid receptors (100 meter spacing) for a 20 km (east-west) x 20 km (north-south) grid centered on the proposed facility site.

At the Department's request, elevated receptors were placed at the Fresh Kills Landfill on Staten Island, New York. Data from the New York City Department of City Planning was used to accurately define elevations in this area. A total of 29 receptors within the current modeling domain were adjusted to reflect the final contours of the piles, while 6 additional receptors were added corresponding to the highest point at each of the 6 major landfill piles. For these 35 receptors, it was necessary to adjust the "scale height" parameter, as AERMOD will not accept a receptor with a "scale height" value that is less than the elevation of the receptor. As such, the "scale height" parameter was set equal to the receptor elevation for these receptors. A list of the 35 Fresh Kills Landfill receptors is provided in Table 5-5.

Also at the Department's request, an additional model run will be executed with additional receptors with a spacing of 50 meters placed in the area of maximum impacts. Receptors will be placed along the facility fence line or property boundary every 25 meters. Grid receptors within the fenced plant property will be excluded from the grid as public access will be precluded in this area.

5.10 Background Ambient Air Quality

Based on a review of the locations of NJDEP ambient air quality monitoring sites, the closest NJDEP monitoring site will be used to represent the current background air quality in the site area, if necessary. Background data for CO and SO_2 was obtained from a New Jersey monitoring station located in Union County (EPA AIRData #34-039-0004). The monitor is located at Interchange 13 on the New Jersey Turnpike (Elizabeth Lab), approximately 17 km northeast of the proposed facility. This monitor is located in an area with a greater amount of mobile and point sources of air emissions as compared to the project area. Thus, this monitor would be considered to conservatively represent the ambient air quality within the project area. Background data for PM-10 was obtained from a Jersey City monitoring station located in Hudson County, New Jersey (EPA AIRData # 34-017-1003), approximately 32 km northeast of the proposed facility. The monitor is located at 355 Newark Avenue in a commercial/urban area. This monitor is located in an area with a greater amount of mobile and point sources of air emissions as compared to the project area. Thus, this monitor would be considered to conservatively represent the ambient air quality within the project area.

Background data for NO_2 was obtained from an East Brunswick monitoring station located in Middlesex County, New Jersey (EPA AIRData # 34-023-0011), approximately 11 km west-southwest of the proposed facility. The monitor is located at Rutgers University (Veg. Research Farm #3 on Ryders Lane) in an agricultural/rural area with proximate commercial uses (i.e., Route 1 and Interstate 95). This monitor's close proximity to the Project site would qualify it to be representative of the ambient air quality within the project area.

Background data for PM-2.5 was obtained from a New Brunswick Township monitoring station located in Middlesex County, New Jersey (EPA AIRData # 34-023-0006), approximately 10 km west-southwest of the proposed facility. The monitor is located at Rutgers University's Cook College (Log Cabin Road) in an agricultural/rural area with proximate commercial uses. This monitor's close proximity would qualify it to be representative of the ambient air quality within the project area.

The monitoring data for the most recently available three years (2013 – 2015) are presented and compared to the NAAQS in Table 5-4. The maximum measured concentrations for each of these pollutants during the last three years are all below applicable standards and are proposed to be used in a NAAQS analysis should one be required.

5.11 NAAQS/NJAAQS Analysis

The NAAQS/NJAAQS will be evaluated by showing that the combined impacts of the proposed facility (Keasbey Energy Center) and the existing Woodbridge Energy Center plus the ambient background are less than the NAAQS/NJAAQS values for applicable averaging periods. The first step of conducting the NAAQS/NJAAQS analysis will be to determine the pollutant specific area(s) of impact of the proposed facility. The area of impact corresponds to the distance at which the model calculated pollutant concentrations fall below the SILs. The second step is obtaining off-site major source inventories within the area of impact plus a distance to be determined based upon discussions with NJDEP. Discussions with NJDEP will be centered on the development of an off-site source inventory and the procedures recommended for preparing a multiple source inventory. If required, these off-site major sources will be included in the NAAQS/NJAAQS modeling analysis along with all sources at the proposed and existing facilities. The resultant concentrations will then be added to the representative background concentration for comparison to the NAAQS/NJAAQS. If the modeled concentration plus the background concentration is less than the NAAQS/NJAAQS, the proposed facility is considered acceptable relative to the NAAQS/NJAAQS. Even if the combined Keasbey Energy Center and Woodbridge Energy Center modeled concentrations are less than the SILs, CPV Keasbey, LLC will demonstrate that the combined modeled impacts plus representative background concentrations will be in compliance with the NAAQS/NJAAQS presented in Tables 4-2a and 4-3, respectively.

5.12 PSD Increment Analysis

The proposed facility is located in a PSD Class II area. CPV Keasbey, LLC will demonstrate that its modeled impact (Keasbey Energy Center) combined with the existing Woodbridge Energy Center will be in compliance with the Class I and Class II PSD increments established for SO_2, NO_2, and PM-10/PM-2.5 presented in Tables 4-2b and 4-2d.

CPV Keasbey, LLC will incorporate the draft modeling guidance as provided in the US E.P.A. guidance memoranda dated May 20, 2014 and August 18, 2016 as they pertain to the modeling of PM-2.5 PSD increments. Specifically, CPV Keasbey, LLC will use the following baseline dates to identify major and minor sources which may be included in a cumulative PSD increment assessment, and will work with the NJDEP Bureau of Evaluation and Planning to develop an appropriate modeling inventory.

- The major source baseline date was established October 20, 2010.
- The minor source baseline date was established February 1, 2016.
- The area was designated attainment for PM2.5 on September 4, 2013.

5.13 Environmental Justice

As it relates to Executive Order 12898 ("EO"), entitled "Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations" (February 11, 1994), TRC will prepare an environmental justice (EJ) analysis that is designed to determine whether the construction and operation of the proposed project will have a significant adverse and disproportionate effect on an "environmental justice community." The EO requires federal agencies to consider disproportionately high adverse human health or environmental effects of their actions on minority and low-income populations. Pursuant to the EO, EJ considerations are taken into account during PSD review.

5.14 Threatened and Endangered Species

As it relates to Section 7 of the Endangered Species Act (ESA), TRC will consult with the U.S. Fish and Wildlife Service (FWS) and/or U.S. Marine Fisheries (MF) to determine if the proposed project may affect any endangered species. At a minimum, this requires notifying and/or providing a copy of the PSD application to the FWS and/or MF.

5.15 Additional Impact Analyses

In addition to assessing impacts on the NAAQS and PSD increments, facilities subject to PSD review must assess the potential impact for the area as a result of growth, and the potential impacts to soils, vegetation, and visibility in the area surrounding the proposed facility.

5.15.1 Assessment of Impacts due to Growth

The proposed facility will be reviewed to assess the potential for affecting local and regional industrial, commercial, and residential growth. Factors that will be examined include the effects the transient working force will have during construction, which is anticipated to occur for up to 30 months, with a currently planned 2020 commercial operation date. If an increase in the permanent working force is required, the effects on the local growth will also be examined. Other effects to growth that will be examined include the air quality constraints the emissions from the proposed facility will have on precluding new growth, and the potential for drawing new industrial growth due to the electricity generated.

5.15.2 Assessment of Impacts on Soils and Vegetation

Pursuant to PSD regulations, an assessment of the potential impacts of the proposed facility on soils and vegetation will be prepared. The methodology outlined in A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals, EPA 450/2-81-078 will be used. This assessment will compare the maximum-modeled facility impacts plus background to pollutant-specific vegetation screening concentration levels found in Table 5-6. These pollutant-specific concentration levels are minimum pollutant concentration levels at which damage to the natural vegetation and predominant crops could occur. Of the pollutants emitted by the proposed facility that triggered PSD review, vegetative screening concentrations are available for CO, SO_2, and NO_2. Screening concentrations for particulate matter are not currently available. Therefore, if the maximum-modeled concentrations are less than the pollutant-specific concentration levels, then no damage to vegetation will be anticipated.

5.15.3 Impact on Visibility

An assessment of the proposed and existing facilities potential impact on visibility within the surrounding area will be performed using the U.S. EPA VISCREEN model (version 13190). In order to assess the potential impact on regional visibility, a conservative Level–1 screening analysis using the VISCREEN model will be conducted. The screening procedure involves calculation of three plume contrast coefficients using emissions of NO_2, PM/PM-10, and sulfates (SO_4). The Level-1 screening procedure determines the light scattering impacts of particulates, including sulfates and nitrates, with a mean diameter of two micrometers with a standard deviation of two micrometers. It will be conducted assuming that all emitted particulate would be as PM-10, which results in a conservative assessment of visibility impact. These coefficients consider plume/sky contrast, plume/terrain contrast, and sky/terrain contrast.

A Level-1 screening analysis using the U.S. EPA VISCREEN (version 13190) model will be performed for the calculated facility potential to emit (PTE) emissions using a visual background range of 40 kilometers. This is the visual distance indicated on Figure 9 – Regional Background Values, in the visibility assessment procedure described in the "Workbook for Plume Visual Impact Screening and Analysis" (U.S. EPA, 1988). A neutral or "D" stability and the average wind speed at the Newark Liberty International Airport meteorological tower during the five year period 2010-2014 (4.39 meters per second) will be used. The results of the analysis will be compared to the EPA default criteria for a visibility screening analysis (plume perceptibility less than 2.0 and contrast less than 0.05).

5.15.4 Impacts on Class I Areas

The only Class I area within 300 km of the proposed facility is the Brigantine Wilderness area located in the Edwin B. Forsythe National Wildlife Refuge in New Jersey. This area is located approximately 108 km south of the proposed facility. The Federal Land Manager (FLM) for this Class I area was notified by letter on July 12, 2016 and confirmed on July 13, 2016 that an assessment of Air Quality Related Value (AQRV) impacts in the Class I area will not be required. However, at the Department's request, the applicant re-contacted the FLM of the combined emissions of the proposed Keasbey Energy Center and the existing Woodbridge Energy Center on

December 13, 2016. The FLM has reviewed the revised submittal and has confirmed in a December 13, 2016 email that a Class I AQRV analysis for the proposed and existing facilities is not required. Copies of both the revised letter and the FLM's response are included in Appendix A.

Air quality concentrations of NO_x, SO_2, and PM-10/PM-2.5 in the aforementioned Class I area will be determined using the AERMOD model. Class I screening receptors will be developed by placing a ring of receptors at 50 kilometers from the Proposed Facility site. Actual Class I receptors and heights for the Class I area will be obtained from the National Park Service Air Resources Division. Screening receptors (50 kilometers from the Proposed Facility) within an arc subtended by the minimum and maximum angular directions to the Class I area will be assigned all of the heights within the Class I area in order to develop a set of representative screening receptors at 50 kilometers. Maximum concentrations will be compared to both the PSD Class I SILs and increments as presented in Table 4-2d.

5.16 Modeling Submittal

The permit application for the proposed facility will include a section detailing the modeling methodology and results from the modeling analysis. All final stack parameters and emission rates will be presented in the report. All modeling input and output files used in the analysis will be submitted in electronic format (DVD-ROM) with the permit application.

Table 5-1: Keasbey Energy Center Combustion Turbine Start-up and Shutdown Emission Rates and Stack Parameters (Rapid Response – Natural Gas Fired)

Estimated Combustion Turbine Startup/Shutdown Parameters – Rapid Response (Natural Gas Fired)										
Event	**Elapsed Time (hr)**	**Stack NO_x (lb/event)**	**Stack NO_x (Max lb/hr)**	**Stack CO (lb/event)**	**Stack CO (Max lb/hr)**	**Stack SO_2 (lb/event)**	**Stack SO_2 (Max lb/hr)**	**Average Stack Exhaust Flow (acfm)**	**Average Stack Exhaust Velocity (m/s)**	**Average Stack Exhaust Temperature (Degrees F)**
Cold Startup	0.75	188	188	169	169	2.25	2.25	671,086	8.97	160
Warm Startup	0.67	126	126	140	140	1.94	1.94	671,086	8.97	160
Hot Startup	0.33	67	67	120	120	0.67	0.67	671,086	8.97	160
Shutdown	0.20	7	7	125	125	0.29	0.29	671,086	8.97	160

	Type of Startup or Shutdown Event			
	Cold Startup	Warm Startup	Hot Startup	Shutdown
Duration of Turbine at 0% load prior to Start-up (hours)	72	8	4	-
Maximum Duration of Start-up or Shut-down Event (hours)	0.75	0.67	0.33	0.20
Maximum Number per Year	10	52	200	262

Note: Due to the infrequency of cold startups, modeling of these transient events for 1-hour NO_2 is not proposed.

Table 5-2: Keasbey Energy Center Combustion Turbine Start-up and Shutdown Emission Rates and Stack Parameters (Rapid Response Lite – ULSD Fired)

Estimated Combustion Turbine Startup/Shutdown Parameters – Rapid Response (ULSD Fired)										
Event	**Elapsed Time (hr)**	**Stack NO_x (lb/event)**	**Stack NO_x (Max lb/hr)**	**Stack CO (lb/event)**	**Stack CO (Max lb/hr)**	**Stack SO_2 (lb/event)**	**Stack SO_2 (Max lb/hr)**	**Average Stack Exhaust Flow (acfm)**	**Average Stack Exhaust Velocity (m/s)**	**Average Stack Exhaust Temperature (Degrees F)**
Cold Startup	0.75	229	229	191	191	2.11	2.11	771,103	10.30	160
Warm Startup	0.67	207	207	188	188	1.81	1.81	771,103	10.30	160
Hot Startup	0.33	143	143	177	177	0.61	0.61	771,103	10.30	160
Shutdown	0.12	22	22	32	32	0.25	0.25	771,103	10.30	160

	Type of Startup or Shutdown Event			
	Cold Startup	Warm Startup	Hot Startup	Shutdown
Duration of Turbine at 0% load prior to Start-up (hours)	72	8	4	-
Maximum Duration of Start-up or Shut-down Event (hours)	0.75	0.67	0.33	0.12
Maximum Number per Year	2	3	5	10

Note: Due to the infrequency of ULSD fired startups, modeling of these transient events for 1-hour NO_2 is not proposed.

Table 5-3: Woodbridge Energy Center Combustion Turbine Start-up and Shutdown Permitted Emission Rates and Stack Parameters (Natural Gas Fired)

GE 7FA.05 Combustion Turbine Start-up/Shutdown Parameters							
Event	**Elapsed Time (hr)**	**Stack NOx (lb/hr)**	**Stack CO (lb/hr)**	**Stack SO_2 (lb/hr)**	**Average Stack Exhaust Flow (acfm)**	**Average Stack Exhaust Velocity (m/s)**	**Average Stack Exhaust Temperature (Degrees F)**
Startup – Per Turbine	3.4	112	941	2.6	550,000	8.89	160
Shutdown – Per Turbine	0.5	68.5	618.4	2.6	550,000	8.89	160

Table 5-4: Maximum Measured Ambient Air Quality Concentrations

Pollutant	Averaging Period	Maximum Ambient Concentrations (µg/m³) 2013	2014	2015	NAAQS (µg/m³)	Monitor Location	SIL (ug/m³)	NAAQS – Background (ug/m³)	Is NAAQS – Background Greater than SIL? (Y/N)
SO_2	1-Hour[a] 3-Hour 24-Hour Annual	36.7 28.8 **15.7** 2.6	34.1 28.8 13.1 **2.6**	39.3 **55** 11.8 --	197 1,300 365 80	Elizabeth Lab, Union County, NJ, #34-039-0004	7.8 25 5 1	160 1,245 349 77	Y Y Y Y
NO_2	1-Hour[b] Annual	75.2 18.8	88.4 16.9	90.2 **19.3**	188 100	East Brunswick, Middlesex County, NJ, #34-023-0011	7.5 1	103 81	Y Y
CO	1-Hour 8-Hour	2,300 **1,495**	2,530 **2,070**	**2,760** 1,840	40,000 10,000	Elizabeth Lab, Union County, NJ, #34-039-0004	2,000 500	37,240 7,930	Y Y
PM-10	24-Hour	43	37	**44**	150	Jersey City, Hudson County, NJ, #34-017-1003	5	106	Y
PM-2.5[c]	24-Hour Annual	19.1 8.0	20 8.2	20 7.9	35 12	New Brunswick, Middlesex County, NJ, #34-023-0006	1.2 0.3	15 4	Y Y

[a]1-hour 3-year average 99th percentile value for SO_2 is **36.7** ug/m³.
[b]1-hour 3-year average 98th percentile value for NO_2 is **84.91** ug/m³.
[c]24-hour 3-year average 98th percentile value for PM-2.5 is **19.7** ug/m³; Annual 3-year average value for PM-2.5 is **8.0** ug/m³.
High second-high short term (1-, 3-, 8-, and 24-hour) and maximum annual average concentrations presented for all pollutants other than PM-2.5 and 1-hour SO_2 and NO_2.
Bold values represent the proposed background values for use in any necessary NAAQS analyses.
Monitored background concentrations obtained from the U.S. EPA AIRData, AirExplorer and Air Quality System (AQS) websites.

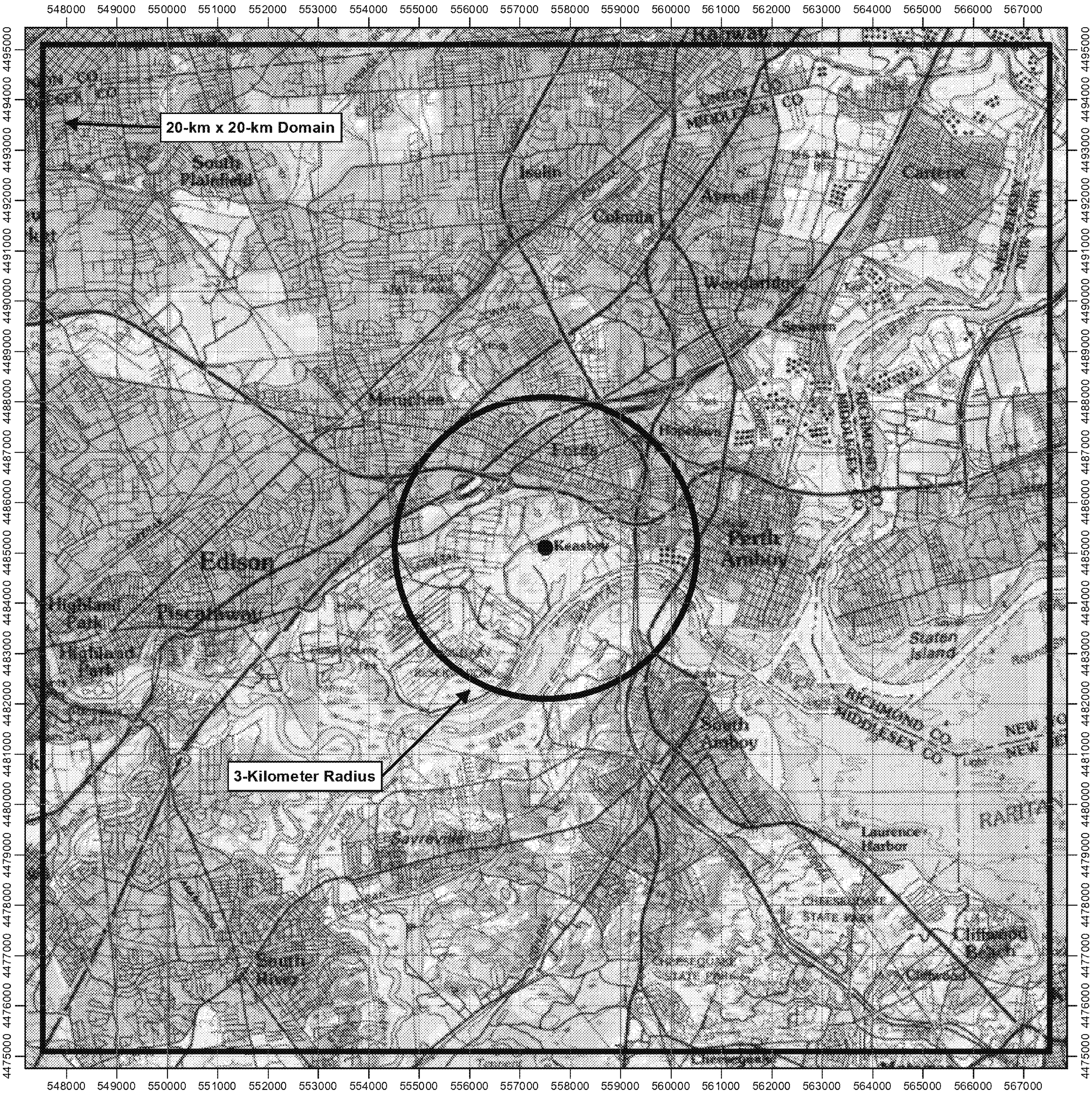
Table 5-5: Fresh Kills Landfill Receptors

UTM Easting (m), NAD83, Zone 18	UTM Northing (m), NAD83, Zone 18	Elevation (m)	Scale Height (m)
566,929	4,490,761	17.5	17.5
566,929	4,490,511	24.0	24.0
566,929	4,490,261	41.2	41.2
566,929	4,490,011	36.3	36.3
567,179	4,491,011	26.7	26.7
567,179	4,490,761	42.2	42.2
567,179	4,490,511	51.1	51.1
567,179	4,490,261	52.6	52.6
567,179	4,490,011	38.8	38.8
567,429	4,491,011	36.6	36.6
567,429	4,490,761	53.1	53.1
567,429	4,490,511	60.4	60.4
567,429	4,490,261	48.3	48.3
567,429	4,490,011	27.4	27.4
569,929	4,493,011	21.4	21.4
567,679	4,491,011	38.1	38.1
567,679	4,490,761	45.2	45.2
567,679	4,490,511	30.8	30.8
567,679	4,490,261	21.8	21.8
568,679	4,491,511	22.7	22.7
568,679	4,492,261	15.0	15.0
568,679	4,492,511	26.8	26.8
568,679	4,492,761	19.4	19.4
568,929	4,492,261	10.8	10.8
568,929	4,492,511	29.4	29.4
568,929	4,492,761	18.3	18.3
569,429	4,491,011	22.0	22.0
569,929	4,492,011	15.2	15.2
569,929	4,492,511	27.7	27.7
568,810	4,492,555	38.1	38.1
569,800	4,492,620	38.1	38.1
569,740	4,491,690	27.4	27.4
568,680	4,491,530	27.4	27.4
569,300	4,490,985	30.5	30.5
567,325	4,490,535	68.6	68.6

Table 5-6: Vegetation Screening Concentrations

Pollutant	Averaging Period	Vegetation Screening Concentrations[a] (μg/m³)		
		Sensitive	Intermediate	Resistant
SO_2	1-Hour 3-Hour Annual	917 786 -	- 2,096 18	- 13,100 -
NO_2	4-Hour 8-Hour Annual	3,760 3,760 -	9,400 7,520 94	16,920 15,040 -
CO	1-Week	1,800,000	-	18,000,000

[a]Screening concentrations found in Table 3.1 of "A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals" (EPA, 1980).
(-) No screening concentration available.



● Site Location

N

0 1,000 2,000
Meters

Base Map: USGS

TRC

Wannalancit Mills
650 Suffolk Street
Lowell, MA 01854
978-970-5600

FULL MODELING DOMAIN AND 3-KM RADIUS AROUND THE PROJECT SITE

KEASBEY ENERGY CENTER WOODBRIDGE, NEW JERSEY

FIGURE 5-1a	July 2016

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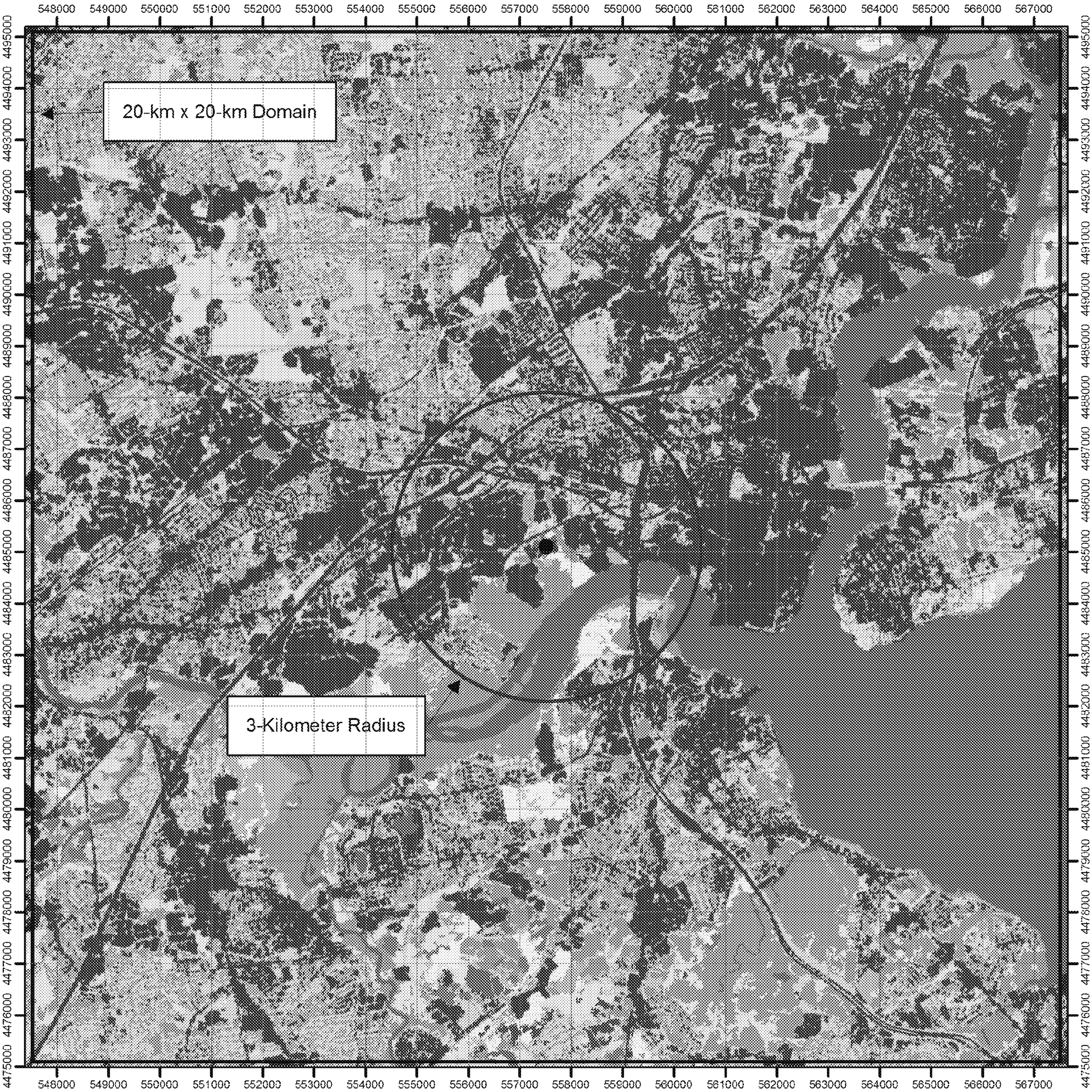

Site Location

2011 NLCD Cat23 + Cat24

11 - Open Water
21 - Developed, Open Space
22 - Developed, Low Intensity
23 - Developed, Medium Intensity
24 - Developed, High Intensity
31 - Barren Land
41 - Deciduous Forest
42 - Evergreen Forest
43 - Mixed Forest
52 - Shrub/Scrub
71 - Grassland/Herbaceous
81 - Pasture/Hay
82 - Cultivated Crops
90 - Woody Wetlands
95 - Emergent Herbaceous Wetlan

N

0 1,000 2,000 Meters

Base Map: USGS

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650 Suffolk Street
Lowell, MA 01854
978-970-5600

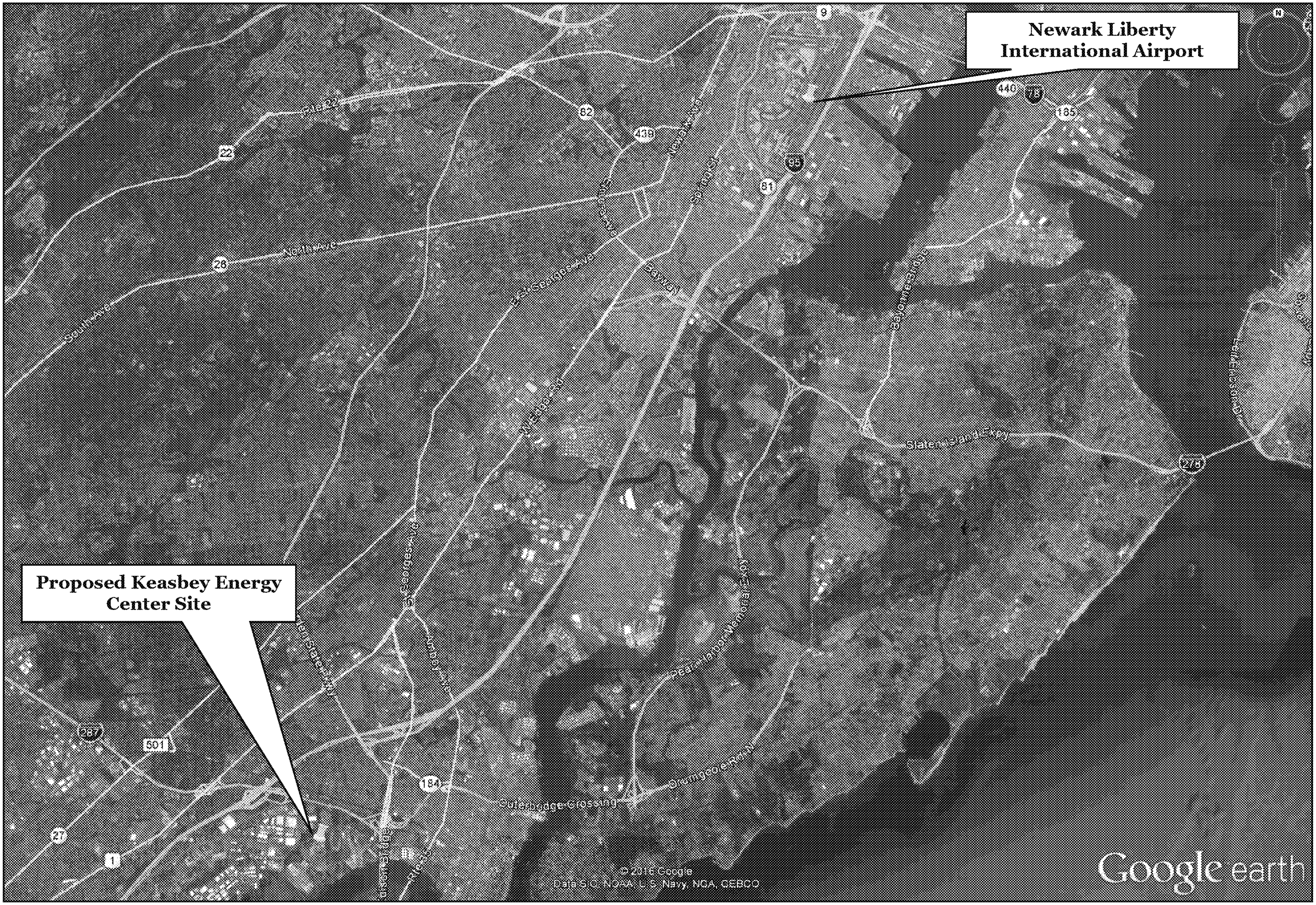
FULL MODELING DOMAIN AND 3-KM RADIUS AROUND THE PROJECT SITE

KEASBEY ENERGY CENTER WOODBRIDGE, NEW JERSEY

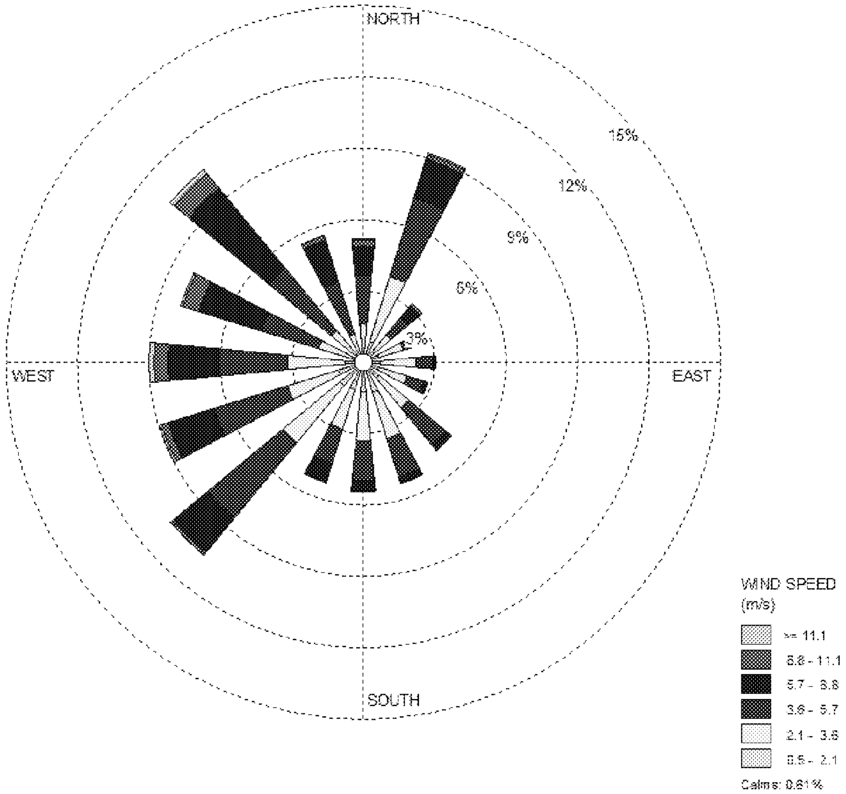
FIGURE 5-1b | **November 2016**

R:\Projects\GIS_2016\252973_Keasbey_Energy\mxd\Fig5-1_Keasbey_20km_Topo_20160705.mxd

Figure 5-2
Location of Proposed Keasbey Energy Center and
Newark Liberty International Airport



WIND ROSE PLOT:
Newark Liberty International Airport Wind Rose (2010-2014)



COMMENTS:	DATA PERIOD:		
	Start Date: 1/1/2010 - 00:00 End Date: 12/31/2014 - 23:00		
	CALM WINDS: 0.61%	TOTAL COUNT: 43720 hrs.	
	AVG. WIND SPEED: 4.39 m/s		PROJECT NO.:

WRPLOT View - Lakes Environmental Software

Keasbey Energy Center
Proposed Combined Cycle Power Facility
Township of Woodbridge, Middlesex County, New Jersey

Figure 5-3: Wind Rose for Newark Liberty International Airport (2010 – 2014)

Source: WRPLOT – Lakes Environmental

TRC

6.0 REFERENCES

NESCAUM, 2013. NESCAUM letter to George Bridgers, Air Quality Modeling Group, U.S.EPA, providing comments to Draft Guidance for PM2.5 Permit Modeling, released by EPA on March 4, 2013. Boston, Massachusetts. May 30, 2013.

NJDEP, 2009. Guidance on Preparing an Air Quality Modeling Protocol. Bureau of Air Quality Evaluation Technical Manual 1002, Trenton, New Jersey.

U.S. EPA, 2017. Revisions to the Guideline on Air Quality Models: Enhancements to the AERMOD Dispersion Modeling System and Incorporation of Approaches to Address Ozone and Fine Particulate Matter. Appendix W to Title 40 U.S. Code of Federal Regulations (CFR) Parts 51 and 52, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency. Research Triangle Park, North Carolina. January 17, 2017.

U.S. EPA, 2014. Guidance for PM-2.5 Permit Modeling, U.S. EPA, May 20, 2014.

U.S. EPA, 2014. Clarification on the Use of AERMOD Dispersion Modeling for Demonstrating Compliance with the NO_2 National Ambient Air Quality Standard. U.S. EPA, September 30, 2014.

U.S. EPA, 2013. Draft Guidance for PM-2.5 Modeling. Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency. Research Triangle Park, North Carolina. March 4, 2013.

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U.S. EPA, 1992. "Screening Procedures for Estimating the Air Quality Impact of Stationary Sources, Revised". EPA Document 454/R-92-019, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina.

U.S. EPA, 1990. "New Source Review Workshop Manual, Draft". Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency. Research Triangle Park, North Carolina.

U.S. EPA, 1985. Guidelines for Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations-Revised). EPA-450/4-80-023R. U.S. Environmental Protection Agency.

U.S. EPA, 1980. A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals. EPA 450/2-81-078. Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency. Research Triangle Park, North Carolina. December 1980.

CHRIS CHRISTIE
Governor

KIM GUADAGNO
Lt. Governor

DEPARTMENT OF ENVIRONMENTAL PROTECTION
AIR QUALITY, ENERGY AND SUSTAINABILITY
DIVISION OF AIR QUALITY
P.O. Box 420 Mailcode 401-02
TRENTON, NJ 08625-0420
609 - 984 - 1484

BOB MARTIN
Commissioner

MEMORANDUM

TO: Aliya Khan, Bureau of Stationary Sources

JL

FROM: Jennifer Levy, Bureau of Evaluation and Planning

DATE: March 28, 2017

SUBJECT: CPV Keasbey, LLC
Air Quality Modeling Protocol dated August 2016
(revised March 2017)
Woodbridge, Middlesex County, New Jersey
PI# 55824 BOP Application Number 160004

CPV Keasbey, LLC is proposing to construct and operate a new 630 MW combined cycle unit, identified as Keasbey Energy Center, directly adjacent to the 725 MW Woodbridge Energy Center, in Woodbridge, Middlesex County, New Jersey. The Keasbey Energy Center will consist of one dual fuel (natural gas or ultra-low sulfur diesel oil) General Electric 7HA.02 combustion turbine, one heat recovery steam generator, one natural gas-fired auxiliary boiler, one emergency diesel generator, one emergency diesel fire pump, a steam turbine generator, and a wet mechanical draft cooling tower. Control devices include dry low-NOx combustors, water injection, selective catalytic reduction (SRC), and oxidation catalyst.

The proposed project will be subject to PSD review for Greenhouse Gases (GHG), nitrogen oxides (NO_x), particulate matter less than 10 microns (PM_{10}), particulate matter less than 2.5 microns ($PM_{2.5}$), carbon monoxide (CO), sulfuric acid mist (H_2SO_4), and sulfur dioxide (SO_2). The project will be subject to non- attainment new source review for NO_x and volatile organic compounds (VOC).

The Bureau of Evaluation and Planning (BEP) in collaboration with EPA Region II has completed its review of the above referenced document. BEP is granting a conditional approval to conduct the air quality dispersion modeling. The conditional approval is dependent on fully addressing the attached comments. If there are any questions regarding the comments, contact Jennifer Levy at (609) 633-8239.

cc:
Bachir Bouzid (BOsS)
Danny Wong (BEP)
Joel Leon (BEP)
Greg John (BEP)
Annamaria Colecchia (EPA- emailed)
Ted Main (TRC)
Michael Keller (TRC)

Bureau of Evaluation and Planning Comments on the CPV Keasbey, LLC Air Quality Modeling Protocol, Dated August, 2016 (Revised March 2017)

General comments

1) CPV Keasbey needs to submit a site survey **with a raised seal** in accordance with the requirements set out in N.J.S.A. 45:8 et seq., N.J.A.C. 13:40-1.1 et seq., and the Bureau's Technical Manual 1002. The survey should include the Woodbridge Energy Center and the Keasbey Energy Center.

2) Please note that the results from the load analysis for all operating scenarios should be discussed with BEP prior to modeling the combined impact. BEP will provide guidance on the scenarios that need to be evaluated for the combined impact assessment. Additionally, the results from the load analysis for all operating scenarios should be presented in the modeling results document.

Section 3.2 Fuels

3) Should the natural gas sulfur content change in subsequent permitting decisions, the modeling must reflect the updated sulfur content.

Section 3.5 Exhaust Stack Configuration and Emission Parameters (Keasbey Energy Center)

4) The text refers to the site plan as a "general arrangement site plan" and the emission rates as "preliminary potential emission rates". This terminology suggests that the building arrangement and emission rates may be subject to change. Please note that if the information presented in this document changes, the modeling analysis will need to reflect the changes.

5) The Department recognizes that operation of the emergency generators and fire pumps will meet the modeling exemption defined in the July 29, 2011 policy memorandum. However, since the air modeling quality evaluation is for a PSD Permit, the impact evaluation must demonstrate compliance with the 1-hour NO_2 and 1-hour SO_2 National Air Quality Standards incorporating guidance outlined in the March 1, 2011 U.S. EPA Memorandum titled, *Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO2 National Ambient Air Quality Standard.*

Section 3.5.2 Combined Modeling of Keasbey Energy Center and Woodbridge Energy Center

6) Refer to general comment 2.

7) Refer to comment 4.

Section 3.6 GEP Analysis

8) BEP is providing a conditional approval to begin modeling, with the condition that additional information must be provided. For example, tables 3-12 and 3-13 create tiered structures for the HRSG while the plot plan does not list this information. Additionally, there are several buildings for Keasbey Energy Center that are not identified on the plot plan and not included in the GEP analysis. The revised plot plan (per comment 1) must include and label all structures and the downwash analysis must be revised to reflect these buildings.

Table 4-2a

9) Typo in footnote "d": It should be noted that the design value for the 24-hour averaging period is based on the 3-year average of the 24-hr 98[th] percentile.

Section 5.6 and 5.6.2 Startups/Shutdowns

10) All short-term averaging time air quality standards (1-hr, 3-hr, 8-hr, 24-hr) must be modeled for startup and shutdown events.

11) The 1-hr NO_2 modeling exemption due to transient events must refer to the combined operations of both power plants. The request to exempt 1-hr NO_2 modeling for cold gas fired rapid starts and for cold ULSD fired rapid starts is based only on Keasbey's operations, and, therefore does not apply to the combined facility. Since Woodbridge does not have ULSD operation, the 1-hr NO_2 modeling can be considered transient for the facility. However, the 1-hr NO_2 natural gas fired cold startups at Keasbey must be included in the combined facility modeling.

12) If there are no permit limits for Woodbridge startups and shutdowns, the annual modeling must assume continuous startup emissions and stack parameters. For example, previous modeling for Woodbridge assumed 10 cold starts, 200 hot starts, and 52 warm starts.

13) Startup emissions must be included in the annual averaging modeling for all relevant criteria pollutants.

14) Add a section to the protocol providing details for how annual emissions are calculated for all relevant criteria pollutants. Note that all supporting calculations pertaining to the modeling analysis must be included in the modeling protocol. Additionally, the statement, "For annual averaging periods, start-ups will only be included in the modeling analysis if the potential to emit for the facility increases due to the inclusion of start-ups into the annual potential to emit calculation" is not valid. The annual potential to emit calculation must include startups and shutdown emissions.

Section 5.7 1-hour NO2 Modeling

15) See comment 4.

Section 5.8 NJDEP Air Toxics Risk Analysis

16) A table containing all HAPs, their emission rates, the source, the reference concentrations, and the unit risk factors must be provided. Additionally, a table containing the cancer risk, short term non-cancer risk and long term non-cancer risk results from the facility should be provided in the modeling results document. Should the maximum modeled short or long term risk exceed the threshold value for any pollutant, a map depicting all areas exceeding the threshold should be provided to show the spatial and quantitative extent of the impact.

Message

From: Zhang, Yiling (DEP) [Yiling.Zhang@dep.nj.gov]
Sent: 5/27/2021 6:15:38 PM
To: Colecchia, Annamaria [Colecchia.Annamaria@epa.gov]; Sareen, Neha [sareen.neha@epa.gov]
CC: greg.john@dep.nj.gov
Subject: FW: Keasbey Energy Center Project (Facility ID 18940, Permit Activity BOP160004) - Air Quality Modeling Report (May 2021)
Attachments: Keasbey Energy Center_PSD Application_Revised Section 5_May 2021_FINAL TO NJDEP.pdf

Hi Annamaria and Neha,

Please see the forwarded Keasbey modeling report.

Thanks,
Yiling

From: Ometz, Darin <DOmetz@trccompanies.com>
Sent: Wednesday, May 26, 2021 4:10 PM
To: John, Greg (DEP) <Greg.John@dep.nj.gov>
Cc: Zhang, Yiling (DEP) <Yiling.Zhang@dep.nj.gov>; Owen, David (DEP) <David.Owen@dep.nj.gov>; Andrew Urquhart <aurquhart@cpv.com>; Leon, Joel (DEP) <Joel.Leon@dep.nj.gov>; Khan, Aliya (DEP) <Aliya.Khan@dep.nj.gov>; Keller, Michael <MKeller@trccompanies.com>
Subject: [EXTERNAL] Keasbey Energy Center Project (Facility ID 18940, Permit Activity BOP160004) - Air Quality Modeling Report (May 2021)

Greg,

TRC is submitting the attached revised Air Quality Modeling Analysis Report for the Keasbey Energy Center Project (Facility ID 18940, Permit Activity BOP160004) in response to the Department's October 29, 2020 notice of technical deficiency and approval of the air quality modeling protocol (Revision 3) on April 19, 2021. As you are aware and were a participant to, the NJDEP and CPV Keasbey had a virtual meeting on November 17, 2020 to discuss the Department's expectations with regards to updating the air dispersion modeling analysis, and report.

As requested, the revised Air Quality Modeling Report includes the necessary updates to the U.S. EPA dispersion model versions, updates to the meteorological and background monitoring concentration data, and updates to the facility emissions and design details that were provided in the single source air quality modeling analysis report (September 2017) and approved on November 20, 2017.

In response to the Bureau of Evaluation and Planning's April 19, 2021 approval of the Air Quality Modeling Protocol (Revision 3, dated February 2021), please find the following in the attached:

- Revised Air Quality Impact Analysis (Section 5) of the PSD permit application, Revised Appendix D (Agency Correspondence), and Appendix J (Modeling Results for Keasbey and Woodbridge as Independent Operations).

For ease of reference, each comment from your April 19, 2021 letter has been restated with a response to the comment following in the attached cover letter. The revised Appendix H (Modeling Input and Output Files DVD) has been sent via Fedex to your attention.

If you have any questions concerning the attached air quality modeling report, please feel free to call me at (201) 508-6964. We look forward to receiving the Department's review comments/approval, as well as the opportunity to continue working with you on this project.

Regards,
Darin

Darin Ometz
Senior Air Quality Project Manager

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May 26, 2021

Mr. Greg John
Division of Air Quality, Bureau of Evaluation and Planning
New Jersey Department of Environmental Protection
401 E. State Street, 2nd Floor
Trenton, New Jersey 08625

Re: Technical Deficiencies: Title V Signification Modification
Woodbridge Energy Center (Keasbey Energy Center Project)
Permit Activity Number: BOP160004 / Program Interest Number: 18940
Submittal of Revised Air Quality Modeling Analysis

Dear Mr. John:

TRC Environmental Corporation (TRC) is submitting the enclosed revised Air Quality Modeling Analysis for the Keasbey Energy Center Project (Facility ID 18940, Permit Activity BOP160004) in response to the Department's October 29, 2020 notice of technical deficiency and approval of the air quality modeling protocol (Revision 3) on April 19, 2021. As you are aware and were a participant to, the NJDEP and CPV Keasbey had a virtual meeting on November 17, 2020 to discuss the Department's expectations with regards to updating the air dispersion modeling analysis, and report.

As requested, the revised Air Quality Modeling Report includes the necessary updates to the U.S. EPA dispersion model versions, updates to the meteorological and background monitoring concentration data, and updates to the facility emissions and design details that were provided in the single source air quality modeling analysis report (September 2017) and approved on November 20, 2017.

In response to the Bureau of Evaluation and Planning's April 19, 2021 approval of Air Quality Modeling Protocol (Revision 3, dated February 2021), please find the following below and attached:

- Revised Air Quality Impact Analysis (Section 5) of the PSD permit application, Revised Appendix D (Agency Correspondence), Revised Appendix H (Modeling Input and Output Files), and Appendix J (Modeling Results for Keasbey and Woodbridge as Independent Operations).

For ease of reference, each comment from your April 19, 2021 letter has been restated with a response to the comment following.

General comments

Q1. A general recommendation is to include links to guidance that are cited in the protocol and future reports.

Response:
The appropriate links to guidance documents have been added to the list of references in Section 5.13.

Section 3.2 - Fuels
Q2. Per BEP Comment Q3 of December 8, 2016, Keasbey added two paragraphs on how natural gas sulfur content was determined in its March 2017 modeling protocol. These two paragraphs were removed from the February 2021 protocol Revision 3 and should be added back to this updated modeling protocol.

BEP acknowledges that the proposed pipeline sulfur content has been revised from 0.63 to 0.75 grain per 100 scf.

Response:
The discussion on the determination of the natural gas sulfur content has been added to Section 5.6 of the attached revised Air Quality Modeling Report (May 2021).

Section 3.3 - Operation
Q3. It has been established during the previous protocol review that Keasbey's air quality impact analysis will include PSD Class I increments. This section only referred to Class II increments.

Response:
The discussion on Class I increments has been added to Section 5.7 of the attached revised Air Quality Modeling Report (May 2021).

Section 3.4 - Selection of Sources for Modeling
Q4. This section states that "The emergency equipment may operate for up to one hour per day for readiness testing and maintenance purposes ."

Other sections of the protocol referred to testing the emergency equipment not more than once per week (with test durations limited by permit condition to no more than 30 minutes) and 100 hours per year per equipment.

Response:
Any references to operating the emergency equipment for up to one hour have been removed from the revised Air Quality Modeling Report (May 2021). The testing for the emergency equipment will have test durations limited by permit condition to no more than 30 minutes.

Section 3.5 - Exhaust Stack Configuration and Emission Parameters (Keasbey Energy Center)a
Q5. In Table 3-2 and subsequent tables, there is a missing footnote for the "a" next to PM-10/PM-2.5.

Response:
The referenced footnote "a" is not applicable to the current analysis and has been removed from the Tables in the attached revised Air Quality Modeling Report (May 2021).

Q6. Section 3.5.3: For the MERPS analysis, please justify the use of the hypothetical source in Bronx, NY instead of the more rural source in Warren, NJ.

Information that could be used to describe the comparability of two different geographic areas include: nearby local and regional sources of pollutants and their emissions (e.g., other industry, mobile, biogenics) , rural or urban nature of the area, terrain, ambient concentrations of relevant pollutants where available, average and peak temperatures, humidity.

From Section 4 of the MERPS guidance:
The permit applicant should provide the appropriate permitting authority with a technically credible justification that the source characteristics (e.g., stack height, emissions rate) of the specific project source described in a permit application and the chemical and physical environment (e.g., meteorology, background pollutant concentrations, and regional/local emissions) near that project source are adequately represented by the selected hypothetical source(s).

Response:
The justification on the use of the hypothetical source in Bronx, NY instead of the more rural source in Warren, NJ, has been added to Section 5.6.7 of the attached revised Air Quality Modeling Report (May 2021).

Section 4.1.3 - Preconstruction Ambient Air Quality Monitoring Exemption
Q7. For the preconstruction monitoring waiver, it is recommended that the applicant include a note if there has been any additional activity in the area since the approved waiver in 2016.

Response:
A note on additional activity in the Project area and background monitoring trends applicable to the preconstruction monitoring waiver has been added to Section 5.3 of the attached revised Air Quality Modeling Report (May 2021).

Section 4.2 - New Jersey Department of Environmental Protection Regulations
Q8. The applicant can remove ULSD from the 1st bullet and remove combustion turbine from the list of equipment.

Response:
The references to ULSD operation for the combustion turbine have been removed from the attached revised Air Quality Modeling Report (May 2021).

Section 5.1 - Model Selection
Q9. A new AERMOD version is expected to be released later this Spring. The new model version should be used unless the applicant can discuss that the new model version will not affect any of the modeling scenarios or results.

Response:
The AERMOD model version (19191) as proposed in the air quality modeling protocol (Revision 3) and approved on April 19, 2021, was utilized in the attached revised Air Quality Modeling Report (May 2021). Subsequent to preparation of the revised air quality modeling, the U.S. EPA has released AERMOD model version 21112 on May 11, 2021. Note that the new model version does not affect any of the modeling results or scenarios as discussed below.

Based on a review of the U.S. EPA's Model Change Bulletion#15, the AERMOD model did not undergo any coding changes that would alter the results or methodologies for the Keasbey Energy Center modeling assessment.

(https://gaftp.epa.gov/Air/aqmg/SCRAM/models/preferred/aermod/aermod_mcb15_v21112.pdf)

The U.S. EPA Model Change Bulletin #15, indicates that there have been no "formulation updates" to the "regulatory options" of the code, which was the option utilized for the Keasbey Energy Center modeling analysis. Additionally, none of the bug fixes or model enhancements are appliable to the Keasbey Energy Center modeling methodologies or inputs.

As such, the modeling results with utilizing AERMOD version 19191 are expected to be identical to the modeling results with AERMOD version 21112 for all modeled operating scenarios, pollutants, and averaging periods. The applicant remodeled a select number of modeling cases with AERMOD version 21112 and the results were identical to AERMOD version 19191. These additional modeling runs are provided in Appendix H to the attached revised Air Quality Modeling Report (May 2021).

Section 5.2 - Surrounding Area and Land Use
Q10. Please include the version of AERSURFACE and the land use years used. Please include a population density evaluation to support the selection of rural dispersion coefficients.

Response:
The discussion on the use of the population density procedure and evaluation has been added to Section 5.4.1 of the attached revised Air Quality Modeling Report (May 2021). As detailed in Section 5.4.1, the land use analysis was based on United States Geological Survey (USGS) National Land Cover Dataset for 2011. Note that the applicant did not utilize the AERSURFACE program for developing the land use analysis.

Section 5.6 - Startups/Shutdowns (Keasbey Energy Center) & Table 5-1
Q11. In the Keasbey's March 2017 protocol , three rapid response startup scenarios were proposed for cold startups (10 times), warm startups (52 times) and hot startups (200 times) with emission rates and stack parameters provided for each startup type (Table 5-1). The current revised protocol only provided information for one rapid response startup scenario (262 times, Table 5-1). Please clarify these differences and outline the number and type of startups and shutdowns for each of the combustion turbines where applicable.

Response:
Table 5-1 provides the emission rates and stack parameters during startup and shutdown operation to reflect the most recent single source modeling analysis (September 2017) and pre-draft permit (February 2018). The three separate startup types provided in the March 2017 protocol were consolidated into a single startup type for consistency with the pre-draft permit (February 2018), which were also utilized in the approved single source modeling analysis (November 20, 2017). Thus, the references to multiple startup types (i.e., cold, warm, hot) have been removed from the attached revised Air Quality Modeling Report (May 2021).

Q12. Section 5.6.2: In the following sentence, "As such, the 1-hour NO_2 modeling analysis will not include an operating scenario with simultaneous operation of the two (2) combustion ..." Did the applicant mean to say, "simultaneous **startup** operation"?

TRC

Response:
The clarification of simultaneous "startup" operation has been added to Section 5.6.12 of the attached revised Air Quality Modeling Report (May 2021).

Q13. Section 5.6.2: In the following sentence, "This operating scenario can be included in the operating permit with a permit condition as shown below that indicates that the Woodbridge Energy Center startup scenario cannot occur simultaneously with Woodbridge Energy Center startup of both combustion turbines for more than 7 days per year." Please correct one of the instances of Woodbridge to say Keasbey.

Response:
The correction of the first instance of Woodbridge Energy Center has been changed to Keasbey Energy Center in Section 5.6.12 of the attached revised Air Quality Modeling Report (May 2021).

Section 5.7 - 1-Hour NO2 Modeling
Q14. Please ensure that the ozone concentration units used with PVMRM are correctly interpolated to model results in $\mu g/m^3$.

Response:
The AERMOD model version (19191) as proposed in the air quality modeling protocol (Revision 3) and approved on April 19, 2021, was utilized in the attached revised Air Quality Modeling Report (May 2021). The AERMOD model was run with the appropriate ozone concentration units such that the AERMOD model would accurately interpolate the ozone concentrations from ppb to ug/m^3. The ozone file for use with the PVMRM option in AERMOD was utilized with the following AERMOD O3Units command line "CO OZONEFILE OZONE.DAT PPB" to ensure that AERMOD would interpolate the ozone concentrations into ug/m^3.

Q15. The air quality modeling report should include correspondence regarding the use of PVMRM, such as the CPV Keasbey request letter, dated June 21, 2017, and the Department's comment/approval letter, dated July 19, 2017. In addition, document all updates and variations from the previously approved approach.

Response:
The correspondence regarding the use of PVMRM, including the CPV Keasbey request letter, dated June 21, 2017, and the Department's comment/approval letter, dated July 19, 2017 are provided in Appendix D to the attached revised Air Quality Modeling Report (May 2021). Updates to the PVMRM modeling input parameters are provided in Sections 5.6.3 to 5.6.6 of the revised Air Quality Modeling Report (May 2021) .

Section 5.8 - NJDEP Air Toxics Risk Analysis

Q16. This section stated that, for HAPs exceeding reporting thresholds, the 24-hour and annual concentrations will be modeled. However, many HAPs' short-term reference concentrations are 1-hour average based. Please model with the appropriate average time. Also, add "and unit risk factors" to the sentence "The combined concentrations from Keasbey and Woodbridge will be evaluated against the reference concentrations found in the NJDEP Risk Technical Manual 1003 and risk screening worksheet" .

Response:
The addition of "unit risk factors" has been added to Section 5.10 of the attached revised Air Quality Modeling Report (May 2021).

Q17. Add a table listing the HAPs to be modeled, including short-term and long-term average emission rates and toxicity thresholds.

Response:
The HAPSs and emission rates are provided in Table 5-33 and the toxicity thresholds are provided in Table 5-34 of the attached revised Air Quality Modeling Report (May 2021).

Section 5.12 - PSD Increment Analysis

Q18. Please specify the pollutants for the following minor source baseline dates:
Nov. 3, 1977 is for SO2
Nov. 15, 1978 is for PM10

Response:
The applicant acknowledges that the minor source baseline date of Nov. 3, 1977 is for SO2 and Nov. 15, 1978 is for PM10. The pollutants associated with these baseline dates will be documented in an updated multisource modeling protocol to be submitted to the Department.

Section 5.15.4 - Impacts on Class I Areas

Q19. Since it has been close to five years since first corresponding with the Federal Land Manager (FLM) regarding this project, the BEP suggests contacting the FLM again to confirm the FLM's 2016 response.

Response:
The FLM for Brigantine Wilderness Area was notified on July 12, 2016 to determine if assessments of impacts in the Class I area would be required. The FLM reviewed the proposed facility's details and related correspondence and confirmed in a July 13, 2016 email that a Class I AQRV analysis for the proposed facility is not required. Subsequently and at the Department's request, the applicant re-contacted the FLM on December 13, 2016. The FLM reviewed the revised submittal and confirmed in a December 13, 2016 email that a Class I AQRV analysis for the proposed facility is not required. Correspondence with the FLM is provided in Appendix D of the attached revised Air Quality Modeling Report (May 2021).

The applicant notes that the FLM's December 2016 determination was based on an analysis for the Q/D ratio that included operation of the Keasbey Energy Center combustion turbine on ULSD. As indicated in the attached revised Air Quality Modeling Report (May 2021), operation of the Keasbey Energy Center combustion on ULSD is not proposed. Thus, the emissions rates that were provided to the FLM in Table 1 of the December 13, 2016 notification are very conservative to the proposed emission rates that reflect operation of the Keasbey Energy Center combustion turbine on natural gas only.

In addition, the FLM Guidance document that was utilized as the basis for the FLM's determination in December 2016 has not been updated since 2010 (Federal Land Managers' Air Quality Related Values Work Group (FLAG) Phase I Report – Revised (2010) NPS/NRPC/NRR

– 2010/232) as indicated in NJDEP TM1002. As such, the methodology utilized in the FLM's determination in December of 2016 remains valid.

Provided that the methodology utilized by the FLM in making their determination from December 2016 is valid and the emissions assessment provided to the FLM in December 2016 is very conservative based on the removal of ULSD operation from the facility, the applicant concluded that the FLM's determination remains valid.

If you have any questions concerning the attached air quality modeling report, please feel free to call me at (201) 508-6964. We look forward to receiving the Department's review comments/approval, as well as the opportunity to continue working with you on this project.

Sincerely,

TRC

Darin Ometz

Darin Ometz
Senior Air Quality Project Manager

CC: A. Urquhart, CPV (via email)
D. Owen, NJDEP (via email)
A. Khan, NJDEP (via email)
J. Leon, NJDEP (via email)
Y. Zhang, NJDEP (via email)
M. Keller, TRC (via email)

CPV Keasbey, LLC
Keasbey Energy Center Project
(Facility ID 18940)

Air Quality Modeling Report
Section 5 – Air Quality Impact Analysis (Revised)

Prepared for:

CPV Keasbey, LLC

Prepared by:

TRC

TRC Environmental Corporation
1099 Wall Street West, Suite 250B
Lyndhurst, NJ 07071

September 2017
Revised May 2021

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5.0 AIR QUALITY IMPACT ANALYSIS

5.1 Regional Description

CPV Keasbey, LLC (CPV Keasbey) is proposing to construct a nominal 630-megawatt (MW) combined cycle power facility (to be known as the Keasbey Energy Center) on an approximately eleven (11) acre parcel of land controlled by CPV Shore Urban Renewal, LLC that will share a property boundary with CPV Shore, LLC's (CPV Shore) Woodbridge Energy Center in Woodbridge Township, Middlesex County, New Jersey (both facilities are shown on Figure 5-1). The CPV Keasbey facility (combustion turbine) will be fueled exclusively by natural gas. Ultra-low sulfur diesel (ULSD) will be used to fuel the emergency generator and diesel fire pump.

Existing land uses in the vicinity of the proposed site include industrial development, commercial development, neighborhood businesses, and residential neighborhoods. The nearest residential locations are approximately 0.8 miles (1.3 kilometers) to the northeast), along Sunnyview Oval immediately north of Route 440 and along King Georges Post Road immediately south of Route 440. Access to the property is provided directly from Riverside Drive.

The proposed facility site is located along the northwestern edge of the Atlantic Coastal Plain Province in New Jersey. Terrain elevations in this Province range from sea level to 391 feet above mean sea level (MSL), at Crawford Hill, Holmdel, New Jersey. Topography in the immediate area is generally flat, with elevations at sea level on the Raritan River and elevations rising upwards of and exceeding 200 feet in Fords, New Jersey. The elevation of the proposed facility site is approximately 22.5 feet above MSL.

The proposed facility single 160 foot high exhaust stack will be located at a grade elevation of 22.5 feet above mean sea level and at approximately 40° 30' 53" North Latitude, 74° 19' 16" West Longitude, North American Datum 1983 (NAD83). The approximate Universal Transverse Mercator (UTM) coordinates of the proposed facility stack are 557,515 meters Easting, 4,485,100 meters Northing, in Zone 18, NAD83. Figure 5-2 shows the Proposed Facility location and the surrounding area.

5.2 Background Ambient Air Quality

Background ambient air quality data was obtained from various approved existing monitoring locations. These monitors have been designed, sited, and operated in accordance with U.S. EPA monitoring guidelines in terms of quality assurance and quality control of the data collection and the reliability of the data itself which are outlined at the EPA's Report on the Environment website https://www.epa.gov/report-environment. This website documents the QA/QC components of the data collection process.

Based on review of the locations of NJDEP ambient air quality monitoring sites, the closest NJDEP monitoring sites were used to represent the current background air quality in the site area. Background data for CO and SO_2 was obtained from a New Jersey monitoring station located in in Union County (EPA AIRData #34-039-0004). The monitor is located at Interchange 13 on the New Jersey Turnpike (Elizabeth Lab), approximately 17 km northeast of the proposed facility. This monitor is located in an area with a greater amount of mobile and point sources of air emissions as compared to the project area. Thus, this monitor would be considered to conservatively represent the ambient air quality within the project area.

Background data for PM-10 was obtained from a Jersey City monitoring station located in Hudson County, New Jersey (EPA AIRData # 34-017-1003), approximately 32 km northeast of the proposed facility. The monitor is located at 355 Newark Avenue in a commercial/urban area. This monitor is located in an area with a greater amount of mobile and point sources of air emissions as compared to the project area. Thus, this monitor would be considered to conservatively represent the ambient air quality within the project area.

Background data for NO_2 was obtained from an East Brunswick monitoring station located in Middlesex County, New Jersey (EPA AIRData # 34-023-0011), approximately 11 km west-southwest of the proposed facility. The monitor is located at Rutgers University (Veg. Research Farm #3 on Ryders Lane) in an agricultural/rural area with proximate commercial uses (i.e., Route 1 and Interstate 95). This monitor's close proximity to the Project site would qualify it to be representative of the ambient air quality within the project area.

Background data for PM-2.5 was obtained from an East Brunswick Township monitoring station located in Middlesex County, New Jersey (EPA AIRData # 34-023-0011), approximately 10 km west-southwest of the proposed facility. The monitor is located at Rutgers University's Cook College (67 Ryders Lane) in an agricultural/rural area with proximate commercial uses. This monitor's close proximity would qualify it to be representative of the ambient air quality within the project area.

The monitoring data for the most recent three years (2017 – 2019) are presented and compared to the NAAQS in Table 5-1. The maximum measured concentrations for each of these pollutants during the last three years are all below applicable standards and will be used in the NAAQS analysis.

5.3 Preconstruction Ambient Air Quality Monitoring Exemption

Pursuant to the PSD regulations codified in 40 CFR 52.21, U.S. EPA may exempt a proposed PSD source, otherwise subject to the one-year pre-construction ambient monitoring requirement, if existing quality assured ambient air quality data are available from alternate locations that are representative of conditions at the proposed facility location.

TRC, on behalf of CPV Keasbey, LLC, prepared and submitted a preconstruction monitoring exemption request to the NJDEP for its review on July 12, 2016. A copy of this request is included in Appendix D. U.S. EPA Region II provided comments on this request on July 26, 2016. A copy of these comments is also included in Appendix D. TRC, on behalf of CPV Keasbey, LLC, prepared and submitted a response to the U.S. EPA Regions II's July 26, 2016 comments on the July 12, 2016 preconstruction ambient monitoring waiver request on March 30, 2017. A copy of this response is included in Appendix D. Note that while there has been additional activity within the region since 2016, the ambient background concentrations for all criteria pollutants are lower for the period from 2017-2019 from the period of 2013-2015. As such, the air quality in the area has improved since the issuance of preconstruction monitoring waiver in March of 2017.

5.4 **Modeling Methodology**

Air quality dispersion modeling was performed consistent with the procedures found in the following documents: Guideline on Air Quality Models (Revised) (U.S. EPA, 2017), New Source Review Workshop Manual (U.S. EPA, 1990), Screening Procedures for Estimating the Air Quality Impact of Stationary Sources (U.S. EPA, 1992), Guidance on Preparing an Air Quality Modeling Protocol - Technical Manual 1002 (NJDEP, 2018), and the final version of the Keasbey Energy Center Air Quality Modeling Protocol submitted on February 18, 2021 and conditionally approved by the NJDEP on April 19, 2021.

The following methodology was incorporated into the assessment:

- Use of five (5) years (2013 – 2017) of concurrent meteorological data collected from a meteorological tower at Newark Liberty International Airport, approximately 22 km north-northeast of the proposed facility and from radiosondes launched from Brookhaven National Labs, New York, approximately 127 kilometers to the east of the proposed facility site. It should be noted that AERMOD model-ready surface and profile files were provided by NJDEP for use in the air quality modeling analyses;

- Load screening of the combustion turbine operating scenarios (with and without duct firing and with and without evaporative cooling) at the proposed Keasbey Energy Center firing natural gas to account for varying loads;

- Load screening of the combustion turbine operating scenarios (with and without duct firing and with and without evaporative cooling) at the existing Woodbridge Energy Center firing natural gas to account for varying loads; and,

- Modeling of plant startup/shutdown scenarios as well as modeling of auxiliary equipment (i.e., emergency equipment and auxiliary boilers) at both the existing Woodbridge and proposed Keasbey facilities.

The modeling methodology used for assessing the Proposed Facility's air quality impact is detailed in the following:

- Revised Air Quality Modeling Protocol (Revision 3) submitted to the NJDEP on February 18, 2021.

- NJDEP's conditional acceptance letter (dated April 19, 2021) of the final version of the Air Quality Modeling Protocol submitted on February 18, 2021.

A copy of NJDEP's conditional acceptance letter can be found in Appendix D.

5.4.1 Urban/Rural Area Analysis

A land cover classification analysis was performed to determine whether the urban source modeling option in AERMOD should be used in quantifying ground-level concentrations. The urban option in AERMOD accounts for the effects of increased surface heating on pollutant dispersion under stable atmospheric conditions. Essentially, the urban convective boundary layer forms in the night when stable rural air flows onto a warmer urban surface. The urban surface is warmer than the rural surface because the urban surface cools at a slower rate than the rural surface when the sun sets.

The USGS map (see Figure 5-3a) covering the area within a 3-kilometer radius of the site as well as the full modeling domain (20 kilometers by 20 kilometers) was reviewed and indicated that the majority of the surrounding area includes water, wooded areas, parks, and non-densely packed structures.

Additionally, the "AERMOD Implementation Guide" published on August 3, 2015 cautions users against applying the Land Use Procedure on a source-by-source basis and instead consider the potential for urban heat island influences across the full modeling domain. This approach is consistent with the fact that the urban heat island is not a localized effect, but is more regional in character.

Because the urban heat island is more of a regional effect, the Urban Source option in AERMOD will not be utilized since the area within 3 kilometers of the proposed site as well as the full modeling domain is not located in the New York City metropolitan area and thus, would not be subject to the New York City metropolitan area heat island.

The rural determination is further supported in an area coverage analysis of the United States Geological Survey (USGS) National Land Cover Dataset for 2011 (NLCD2011) (see Figure 5-3b). The percentages of each land use type (according to the Auer Land Use Classification Method) is as follows:

- I1/I2/C1 (Heavy Industrial/Light-moderate Industrial/Commercial): 16% (urban)
- R1 (Common Residential, low intensity): 19% (rural)
- R2/R3 (Compact Residential, high intensity): 25% (urban)
- R4/A1 (Estate Residential/Metropolitan Natural): 9% (rural)
- A3 (Undeveloped/Uncultivated/Wasteland): 15% (rural)
- A4 (Undeveloped/Rural): 5% (rural)
- A5 (Water Surfaces/Rivers/Lakes: 11% (rural)

Further, categories 23 (Developed, Medium Intensity) and 24 (Developed, High Intensity) are 25% and 16%, respectively, of the 3-kilometer radius area, for a total of 41% urban, with the remaining 59% classified as rural.

In order to properly characterize the land use, the classifications of canopy and impervious surface data layers should also be included. Figure 5-3c is included to present the composite land use classifications of impervious surfaces greater than 50% and canopy greater than 40%. In as much as the urban classifications represented by land use categories 23 and 24 are defined by percentage of impervious surface, the pixels for categories 23 and 24 (urban) are identical to impervious surface greater than 50%, and thus no further differentiation between urban or rural land use is provided.

Canopy does not define any other land use category and percent of canopy can be associated with any other category, with the exception of open water-11 and barren-31. Filtering the canopy pixels greater than 40% suggests that canopy would be associated with the vegetated (i.e., rural) categories. In this fashion canopy is already counted in undeveloped, light residential and agriculture land uses (defined as rural), and is not associated with the urban categories of 23 & 24. Therefore, use of canopy and impervious surface provide no additional differentiation between urban or rural land uses.

Population Density Method

Section 7.2.1.1 of the EPA's Guideline on Air Quality Models, Appendix W to 40 CFR Part 51, recommends that the land use classification be determined by use of either the land use procedure discussed above or the population density procedure. The population density procedure is utilized with the following methodology:

1. Compute the average population density (p) per square kilometer within a 3 km radius of the site; and
2. If (p) is greater than 750 people per square kilometer, use urban dispersion coefficients; otherwise use appropriate rural dispersion coefficients.

The population density within a 3-kilometer radius of the Project site was calculated to be 840 people per square kilometer, based on an analysis of the block groups within 3 kilometers of the site utilizing U.S. Census block group data for New Jersey. As such, the population density is slightly above (12%) of the established population density threshold for classification of the area as urban.

However, as indicated in Appendix W to 40 CFR Part 51, the land use procedure is considered the more definitive of the two procedures, and thus, the selection of a rural land use utilizing the land use procedure above is more definitive and accurate to the Project site. Thus, the selection of rural land use is consistent with Appendix W to 40 CRF Part 51 and was utilized in the modeling assessment.

5.4.2 Good Engineering Practice Stack Height

Section 123 of the Clean Air Act (CAA) required the United States Environmental Protection Agency (U.S. EPA) to promulgate regulations to assure that the degree of emission limitation for the control of any air pollutant under an applicable State Implementation Plan (SIP) was not affected by (1) stack heights that exceed GEP or (2) any other dispersion technique. The U.S. EPA provides specific guidance for determining GEP stack height and for determining whether building downwash will occur in the Guidance for Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations), (U.S. EPA, 1985). GEP is defined as "...the height necessary to ensure that emissions from the stack do not result in excessive concentrations of any air pollutant in the immediate vicinity of the source as a result of atmospheric downwash, eddies, and wakes that may be created by the source itself, or nearby structures, or nearby terrain "obstacles"."

The GEP definition is based on the observed phenomenon of atmospheric flow in the immediate vicinity of a structure. It identifies the minimum stack height at which significant adverse aerodynamics (downwash) are avoided. The U.S. EPA GEP stack height regulations (40 CFR 51.100) specify that the GEP stack height (H_{GEP}) be calculated in the following manner:

$$H_{GEP} = H_B + 1.5L$$

Where: H_B = the height of adjacent or nearby structures at ground elevation, and

L = the lesser dimension (height or projected width of the adjacent or nearby structures).

A general arrangement site plan of the proposed Keasbey Energy Center and the existing Woodbridge Energy Center is provided as Figure 5-4. A GEP stack height analysis has been conducted using the U.S. EPA approved Building Profile Input Program with PRIME (BPIPPRM, version 04274). GEP analysis tables can be found in Tables 5-2a and 5-2b. The controlling structure is the HRSG at a height of 94 feet above ground surface grade, resulting in a formula GEP height of 235 feet above grade. It should be noted that blocks or outlines exist on the general arrangement site plan in Figure 5-4 which may be interpreted as being physical "structures" which may affect the building downwash calculations. This is not a correct interpretation of the site plan, and generally, such outlines represent the locations of open pads or equipment enclosures. Where not otherwise specified on the general arrangement site plan, any such "structures" would be less than 35 feet above grade and are not of sufficient height to affect the BPIPPRM calculations for the emission units being assessed. Further, this statement is included as Note 10 in the legend of the general arrangement site plan in Figure 5-4.

Since a non-GEP stack is proposed, direction-specific downwash parameters for the combustion turbine exhaust stack were determined using BPIPPRM, version 04274. Direction-specific downwash parameters for the additional Keasbey auxiliary equipment exhaust stacks that were modeled (i.e., auxiliary boiler, emergency equipment, and cooling tower) were also determined using BPIPPRM, version 04274. Further, direction-specific downwash parameters for the two (2) existing combustion turbines, auxiliary boiler, emergency equipment, and cooling tower at Woodbridge Energy Center were also determined using BPIPPRM, version 04274. Direction-specific building downwash parameters were input to the PSD modeling analysis.

5.4.3 Model Selection

The U.S. EPA has compiled a set of preferred and alternative computer models for the calculation of pollutant impacts. The selection of a model depends on the characteristics of the source, as well as the nature of the surrounding study area. Of the four classes of models available, the Gaussian type model is the most widely used technique for estimating the impacts of nonreactive pollutants.

The AERMOD model was designed for assessing pollutant concentrations from a wide variety of sources (point, area, and volume). AERMOD is currently recommended for modeling studies in rural or urban areas, flat or complex terrain, and transport distances less than 50 kilometers, with one hour to annual averaging times.

AERMOD (version 19191) was used for the PSD modeling of the proposed and existing facilities potential emissions to determine the maximum ambient air concentrations. The regulatory default option was used in the dispersion modeling analyses.

5.4.4 Meteorological Data

Five (5) years (2013 – 2017) of concurrent meteorological data collected from a meteorological tower at Newark Liberty International Airport, approximately 22 km north-northeast of the proposed facility and from radiosondes launched from Brookhaven National Labs, New York, approximately 127 kilometers to the east of the proposed facility were used to create the meteorological dataset (using AERMOD's meteorological processor, AERMET/AERMINUTE version 18081) required for the modeling analyses. The profile base elevation (PROFBASE) in AERMOD has been set to 3.0 meters, which, per the Department, corresponds to the base elevation of the anemometer of the meteorological tower at Newark Liberty International Airport. A wind rose displaying the composite wind rose for all five (5) years of wind speed and wind direction for the Newark Liberty International Airport is shown in Figure 5-5.

5.5 Receptor Grid

Part of the AERMOD package, the receptor-generating program, AERMAP (version 11103) was used to develop a complete 20 km (east-west) x 20 km (north-south) rectangular (i.e., Cartesian) receptor grid (e.g., fine grid receptors ≤ 100 meters), centered on the proposed facility, to assess the air quality impact. AERMOD requires receptor data consisting of location coordinates and ground-level elevations. AERMAP uses digital elevation model (DEM) or the National Elevation Dataset (NED) data obtained from the USGS. The preferred elevation dataset based on NED data was used in AERMAP to process the receptor grid. This is currently the preferred data to be used with AERMAP as indicated in the U.S. EPA AERMOD Implementation Guide published on August 3, 2015. AERMAP was run to determine the representative elevation for each receptor using 1/3 arc second NED files that were obtained for an area covering at least 10 kilometers in all directions from the proposed facility. The NED data were obtained through the Multi-Resolution Land Characteristic Consortium (MRLC) link at http://www.mrlc.gov/viewerjs/.

The following rectangular (i.e. Cartesian) receptors were used to assess the air quality impact of the proposed facility:

- Fine grid receptors (100 meter spacing) for a 20 km (east-west) x 20 km (north-south) grid centered on the proposed facility site (see Figure 5-6).

Receptors were also placed along the facility fence line or property boundary every 25 meters. Ambient air is defined as the area at and beyond the fence. Receptors within the fenced plant property were excluded from the grid since public access will be restricted in this area. At the NJDEP's request, additional model runs were executed with additional receptors with a spacing of 50 meters placed in the area of maximum impacts, unless the area of maximum impact was located among the more refined 25-meter spaced fence line receptors. It should be noted that specifically for the purpose of determining the area of impact for 1-hour NO_2 during startup/shutdown operations, two additional receptor grids were created. Figure 5-7 illustrates the 250-meter spaced receptors out to 25 km and Figure 5-8 illustrates the 500-meter spaced receptors out to 50 km.

At the Department's request, elevated receptors were placed at the Fresh Kills Landfill on Staten Island, New York. Data from the New York City Department of City Planning was used to accurately define elevations in this area. A total of 29 receptors within the current modeling domain were adjusted to reflect the final contours of the landfill piles, while 6 additional receptors were added corresponding to the highest point at each of the 6 major landfill piles. For these 35 receptors, it was necessary to adjust the "scale height" parameter, as AERMOD will not accept a receptor with a "scale height" value that is less than the elevation of the receptor. As such, the "scale height" parameter was set equal to the receptor elevation for these receptors. A list of the 35 Fresh Kills Landfill receptors is provided in Table 5-2c.

5.6 **Source Parameters, Worst Case Load, and Operating Scenario Determination**

The Keasbey Energy Center will consist of one (1) General Electric (GE) 7HA.02 combustion turbine at the proposed facility site. The maximum heat input for this turbine firing natural gas (BACT assumes sulfur in fuel is 0.75 grains/100 SCF at 1,024 Btu/SCF) at -8 degrees Fahrenheit (deg F) is 3,664 million British Thermal Units per hour (mmBTU/hr), Higher Heating Value (HHV). Hot exhaust gases from the combustion turbine will flow into an adjacent heat recovery steam generator (HRSG) that will be equipped with a natural gas fired duct burner. The maximum duct burner heat input capacity firing natural gas is 850 million British thermal units per hour (MMBtu/hr) based on the Higher Heating Value (HHV). The HRSG will produce steam to be used in the steam turbine. Upon leaving the HRSG, the turbine exhaust gases will be directed to one (1) exhaust stack. Other ancillary equipment at the proposed facility will include a gas-fired auxiliary boiler, an emergency diesel fire pump, an emergency diesel generator, and a wet mechanical draft cooling tower. The auxiliary boiler is sized up to 72.3 mmBtu/hr, will fire natural gas exclusively, and operate for up to 4,000 hours per year. The emergency diesel fire pump is sized up to 2.3 mmBtu/hr (305 hp), will fire ULSD, and operate up to 100 hours per year for testing and maintenance. The emergency diesel generator is sized up to 14.4 mmBtu/hr, will fire ULSD, and operate up to 100 hours per year for testing and maintenance.

CPV Keasbey is proposing to utilize natural gas as the primary fuel for the combustion turbine at Keasbey Energy Center. The natural gas is assumed to have a HHV of 1,024 Btu/standard cubic foot (scf) and an estimated sulfur content of 0.75 grains per 100 scf. Natural gas sulfur content data was reviewed for the TETCO and TRANSCO gas suppliers. The TETCO data spans from October 1, 2013 to October 18, 2016, a period slightly more than three years. The TRANSCO data spans June 1, 2014 through June 7, 2016, a period slightly more than two years. This data also supplements the TRANSCO sulfur content data previously provided to the Bureau of Stationary Sources. The CPV Keasbey facility proposes to use either TRANSCO or TETCO gas supply.

The maximum daily sulfur content for either data is 0.55 grains/100 SCF, which is consistent with the maximum value of 0.75 grains/100 SCF used for the Keasbey Energy Center facility permitting. The period average is about 0.2 grains/100 SCF. However, there are notable spikes in sulfur content throughout the period, namely 0.63 grains/100 SCF presented in a prior set of data (provided to the Department), and at 0.55, 0.49, 0.385, and 0.372 in the current data sets. This demonstrates that spikes in sulfur content can and do occur within the gas supply and must be accounted for in the permitting process. As such, 0.75 is selected as the worst case sulfur content for short term sulfur dioxide emissions and for the combustion turbine performance. Note that while 0.75 grains S/100 SCF is the design basis sulfur content based on historical data, the actual natural gas sulfur content for gas to be supplied to the facility is wholly out of the control of CPV Keasbey.

Emissions from the combined cycle unit will be controlled by the use of dry low-NO_x burner technology and SCR for NO_x control; an oxidation catalyst for CO and VOC control; and the use of a clean low-sulfur fuel (i.e., natural gas) to minimize emissions of SO_2, PM/PM-10/PM-2.5, and H_2SO_4. Steam from the steam turbine will be sent to a condenser where it will be cooled to a liquid state and returned to the HRSG. Waste heat from the condenser will be dissipated through the wet mechanical draft cooling tower.

The existing Woodbridge Energy Center consists of two (2) General Electric (GE) 7FA.05 combustion turbines. The maximum heat input for each turbine firing natural gas is 2,307 million British Thermal Units per hour (mmBTU/hr), Higher Heating Value (HHV). Hot exhaust gases from each of the combustion turbines flow into adjacent heat recovery steam generators (HRSGs) that are equipped with natural gas fired duct burners. The maximum duct burner heat input capacity firing natural gas (for each duct burner) is 500 million British thermal units per hour (MMBtu/hr) based on the Higher Heating Value (HHV). The HRSGs produce steam to be used in the steam turbine. Upon leaving the HRSGs, the turbine exhaust gases are directed to two (2) exhaust stacks. Other ancillary equipment at the existing Woodbridge Energy Center includes a gas-fired auxiliary boiler, an emergency diesel fire pump, an emergency diesel generator, and a wet mechanical draft cooling tower. The auxiliary boiler is sized to 91.6 mmBtu/hr, fires natural gas exclusively, and operates for up to 2,000 hours per year. The emergency diesel fire pump is sized to 2.1 mmBtu/hr, fires ULSD, and operates up to 100 hours per year for testing and maintenance. The emergency diesel generator is sized to 13.5 mmBtu/hr, fires ULSD, and operates up to 100 hours per year for testing and maintenance.

Emissions from the combined cycle units are controlled by the use of dry low-NO_x burner technology (during natural gas firing) and SCR for NO_x control; an oxidation catalyst for CO and VOC control; and the use of a clean low-sulfur fuel (i.e., natural gas) to minimize emissions of SO_2, PM/PM-10/PM-2.5, and H_2SO_4. Steam from the steam turbine is sent to a condenser where it is cooled to a liquid state and returned to the HRSGs. Waste heat from the condensers is dissipated through the 14-cell wet mechanical draft cooling tower.

5.6.1 Modeling Emission Parameters (Keasbey Energy Center)

Exhaust characteristics of the turbine/heat recovery steam generator stack during different operating scenarios are provided in Table 5-3. Exhaust parameters are presented for gas firing at three (3) ambient temperatures (-8 degrees Fahrenheit, 59 degrees Fahrenheit, and 105 degrees Fahrenheit), five (5) loads (30%, 46%, 50%, 75%, and 100%), and operating conditions for HRSG duct firing. Table 5-4 presents the potential emission rates for each of the operating scenarios. In addition, emission rates and stack parameters are presented for evaporative cooling during natural gas operation at 100% load. Thus, emission rates and stack parameters for sixteen (16) ambient temperatures and load combinations were used to determine the "worst-case" operating scenario for the turbine.

Tables 5-5 to 5-7 present the stack parameters and emission rates for the auxiliary boiler, emergency diesel fire pump, and emergency diesel generator, respectively. For the proposed emergency diesel generator and emergency diesel fire pump at the Keasbey Energy Center, CPV is proposing to operate each unit up to 100 hours per year, the same conditions that exist for the emergency diesel generator and emergency diesel fire pump at the Woodbridge Energy Center. The emergency diesel generator and emergency diesel fire pump are not expected to be tested more than once per week (with test durations expected to be limited by permit condition to no more than 30 minutes).

Additionally, Table 5-8 presents the stack parameters and PM-10/PM-2.5 emission rates for the wet mechanical draft cooling tower at the proposed Keasbey Energy Center. According to NJDEP guidance found in the Technical Manual 1002: Guidance on Preparing an Air Quality Modeling Protocol (NJDEP, December), the mechanical draft cooling towers at both Woodbridge and Keasbey were included in the modeling analysis for PM-10/PM-2.5 standards compliance since the total PM-10/PM-2.5 emission rate from the towers are greater than 1.0 pound per hour. Since the total combined PM-10 emission rate from both towers is greater than 1.0 pound per hour, both cooling towers were included in the modeling analysis for PM-10 standards compliance. Further, since the total combined PM-2.5 emission rate from both towers is also greater than 1.0 pound per hour, both cooling towers were included in the modeling analysis for PM-2.5 standards compliance. Table 5-9 presents the location coordinates for the proposed wet mechanical draft cooling tower at Keasbey. Additionally, Tables 5-10 and 5-11 present the exhaust parameters, particulate emission rates, and location coordinates for the existing wet mechanical draft cooling tower at the Woodbridge Energy Center.

The air permit application assumes that the Process Water Supply will come from treated effluent from the Middlesex County Utilities Authority (MCUA) and will be the source of the cooling tower water. The particulate matter emissions from the cooling tower are calculated using AP-42 emission factors which includes the circulating water rate, quantity of liquid water drift and the concentration of total dissolved solids (TDS) within the circulating water. Note that there will be no dissolved organic compounds within the effluent and as such there will be no VOC emissions anticipated from the cooling tower. The TDS concentration within the cooling tower circulating water is managed operationally using conductivity as a surrogate for TDS and by increasing or decreasing the cooling tower blowdown rate. This is controlled automatically based on the level set by the control room operator. Tower blowdown is a side-stream of the circulating water that is directed to the wastewater discharge. Increasing the blowdown rate will cause a decrease in the circulating water TDS concentration since a greater flow of lower TDS makeup water is added to the tower. While the makeup water has a fairly low TDS, it is not entirely constant and, as such, monitoring the circulating water TDS and controlling the blowdown rate provide a reliable method for maintaining a constant circulating water TDS.

In order to minimize makeup water flow, the circulating water TDS set point can be set high, which causes a lower blowdown rate. Conversely, in order to minimize tower drift particulate, the circulating water TDS can be set lower, causing the makeup water rate to be increased to a level that will balance the reduced particulate emissions. The tradeoff is with the operating cost of increased makeup water usage.

Since AP-42 does not account for PM-2.5 emissions, the total particulate matter emission rate is separated into PM-10 and PM-2.5 fractions using a droplet size distribution representative of a wet cooling tower using a high-efficiency drift eliminator. The droplet size distribution represents the total liquid drift from the tower, of which, when the droplets evaporate (assumed to be essentially immediately), will form total suspended particulate (TSP). The fractions of PM-10 and PM-2.5 were estimated using the calculation method posited by Reisman and Frisbie (Reisman, J., and Frisbie, G. 2002, Calculating Realistic PM10 Emissions from Cooling Towers, Abstract No. 216 presented at the 2001 94th Annual Air and Waste Management Association Conference and Exhibition in Orlando, Florida, June 25th to 28th). The particle size calculation methodology is based on the Reisman and Frisbie formulas. Note that this method of particulate matter fractionation is endorsed by many regulatory agencies and is included in certain agency air quality modeling guidance documents. As can be demonstrated in the worksheet, the PM-10 and PM-2.5 fractions are calculated using a linear interpolation of the evaporated drift droplet particulates. For reference purposes, the particle size calculation worksheet and the droplet size distribution for an industry standard high efficiency drift eliminator is included in Appendix D.

5.6.2 Modeling Emission Parameters (Woodbridge Energy Center)

The equipment from the existing Woodbridge Energy Center that was included in the air dispersion modeling demonstration included the two (2) combustion turbines, the auxiliary boiler, the emergency diesel fire pump, the emergency diesel generator, and the 14-cell wet mechanical draft cooling tower. The coordinates of the Woodbridge emission units reflect their true "as-built" locations which are presented on the General Arrangement Site Plan in Figure 5-4. Exhaust characteristics of the turbine/heat recovery steam generator stacks during different operating scenarios are provided in Table 5-12. Exhaust parameters are presented for natural gas firing at three (3) ambient temperatures (-8 degrees Fahrenheit, 56 degrees Fahrenheit, and 105 degrees Fahrenheit), three (3) loads (50%, 75%, and 100%), and operating conditions for HRSG duct firing. Table 5-13 presents the potential emission rates for each of the operating scenarios. In addition, emission rates and stack parameters are presented for evaporative cooling during natural gas operation. Thus, emission rates and stack parameters for fourteen (14) ambient temperatures and load combinations were used to determine the "worst-case" operating scenario for the turbines.

Table 5-10 provides exhaust parameters and particulate matter emission rates for the existing wet mechanical draft cooling tower. Exhaust parameters and emissions rates for the existing auxiliary boiler stack are provided in Table 5-14. Tables 5-15 and 5-16 provide exhaust parameters and emission rates for the existing emergency diesel fire pump and existing emergency diesel generator, respectively. The existing emergency diesel generator and emergency diesel fire pump at the Woodbridge Energy Center are each permitted to operate up to 100 hours per year. These permit conditions will remain the same. The emergency diesel generator and emergency diesel fire pump are not tested more than once per week (with test durations limited by permit condition to no more than 30 minutes).

5.6.3 NO_2 Modeling

The air quality modeling analysis for the 1-hour NO_2 NAAQS was performed consistent with the guidance and procedures established in the revised "Guideline on Air Quality Models" (January 17, 2017), the September 30, 2014 guidance memorandum titled "Clarification on the Use of AERMOD Dispersion Modeling for Demonstrating Compliance with the NO_2 NAAQS", and the March 1, 2011 guidance memorandum from Tyler Fox (EPA OAQPS) titled "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-Hour NO_2 NAAQS" (Memorandums). Based upon the discussion in the memorandums regarding the treatment of intermittent sources, the only equipment or operating scenarios that "are continuous or frequent enough to contribute significantly to the annual distribution of daily maximum 1-hour concentrations" were included in the 1-hour NO_2 modeling analysis.

This methodology, per the examples provided in the Memorandums, would exempt any facility equipment or operating scenarios from 1-hour NO_2 compliance modeling that does not operate on a normal daily or routine schedule. For example, the emergency diesel generators and emergency diesel fire pumps are not expected to be tested more than once per week (with test durations limited by permit condition to no more than 30 minutes) and are not expected to contribute significantly to the annual distribution of maximum 1-hour concentrations. For these reasons, and consistent with the Memorandums, the 1-hour NO_2 modeling did not include the emergency diesel generators and emergency diesel fire pumps.

Further, the emergency diesel generators and emergency diesel fire pumps at both Woodbridge and Keasbey were not included in the 1-hour SO_2 and 1-hour NO_2 modeling analyses, per the exemption as defined in the July 29, 2011 policy memorandum issued by NJDEP exempting emergency generator and fire pump NO_x and SO_2 emissions from 1-hour NO_2 and SO_2 air quality modeling at combined cycle turbine facilities. CPV has already agreed to the permit conditions contained in the aforementioned July 29, 2011 policy memorandum for the emergency diesel fire pump and emergency diesel generator at the existing Woodbridge Energy Center and proposes to agree to the same conditions for the Keasbey Energy Center. It should be noted that these permit conditions do not allow for the simultaneous testing of emergency generators and/or fire pumps and limit the durations of the test operations to no more than 30 minutes. Readiness testing of emergency equipment generally occurs approximately once per week.

The other combustion sources at Woodbridge (combustion turbines and auxiliary boiler) and Keasbey (combustion turbine and auxiliary boiler) were included in the 1-hour NO_2 modeling analyses. As previously discussed, startup and shutdown conditions that are expected to contribute to the annual distribution of daily maximum concentrations due to their frequency on a yearly basis were included in the air quality modeling analysis for the 1-hour NO_2 standard.

The following screening options were applied for the various analyses per the guidance specified in the "Revisions to the Guideline on Air Quality Models: Enhancements to the AERMOD Dispersion Modeling System and Incorporation of Approaches to Address Ozone and Fine Particulate Matter", published final in the Federal Register on January 17, 2017, and the U.S. EPA Memorandum "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard" section entitled Approval and Application of Tiering Approach for NO_2 (found on pages 5 through 8 of the memorandum).

Section 5.2.4 of the EPA's Guideline on Air Quality Models, Appendix W to 40 CFR Part 51, recommends a three-tiered screening approach to estimate ambient concentrations of NO_2:

- Tier 1 – assume complete conversion of all emitted NO to NO_2
- Tier 2 – multiply Tier 1 results by a representative equilibrium NO_2/NO_x ratio
- Tier 3 – perform a detailed analysis on a case-by-case basis.

The 1-hour NO2 modeling analysis utilized the U.S. EPA Tier 3 modeling approach for 1-hour NO_2 modeling assessment results using the AERMOD Plume Volume Molar Ratio Method (PVMRM) that adjusts NOx emissions to estimate more realistic ambient NO_2 concentrations by modeling the conversion of NO_x to NO_2. Note that the Tier 2 screening approach using the Ambient Ratio Method 2 (ARM2) is too conservative for this Project.

PVMRM incorporates three sets of data into the calculation of 1-hour NO_2 concentrations. Those are source-specific in-stack NO_2/NO_x emission rate ratios, an ambient NO_2/NO_x concentration ratio, and hourly average background ozone concentrations.

The PVMRM option for modeling conversion of NO to NO_2 incorporated a default NO_2/NO_x ambient equilibrium concentration ratio of 0.90.

5.6.4 In Stack NO2/NOx Concentration Ratio

NO_x consists primarily of nitric oxide (NO) and NO_2, plus small amounts of other compounds. Combustion sources produce NOx by the following three mechanisms:

1. Thermal NOx is produced by the thermal dissociation and subsequent reaction of nitrogen and oxygen (O2) molecules in the combustion air;

2. Fuel NOx is produced by the reaction of fuel-bound nitrogen compounds with O2 molecules in the combustion air; and,
3. Prompt NOx is produced by the formation of hydrogen cyanide (HCN) via the reaction of nitrogen radicals and hydrocarbons (HC), followed by the oxidation of HCN to NO.

NO_2 is produced by the oxidation of NO by O2. This oxidation reaction is favored by a high O2 concentration. Since the reaction is exothermic, NO_2 formation is also favored by low temperature. Hence, rapid cooling of combustion products in the presence of a high O2 concentration will promote conversion of NO to NO_2. Essentially all of the NO_x formed by natural gas and distillate oil combustion sources is thermal NOx because these fuels have little or no chemically bound fuel nitrogen. NOx from fuel combustion typically consists of 90 to 95 percent NO. The balance is primarily NO_2.

The modeling analysis for the facility equipment conservatively utilized the national default in-stack NO_2/NO_x ratio of 0.5.

5.6.5 1-hour NO_2 Background Concentrations

Pollutant background concentrations are required to appropriately assess the ambient air quality concentrations that may contribute to the total ambient pollutant concentrations. Background concentrations are added to model-predicted concentrations to calculate the total concentrations for comparison to the NAAQS. Criteria pollutant background concentration values are derived from ambient air quality data monitored at stations that are determined to be representative of expected background concentrations at the proposed source location and potential impact area. In order to conduct cumulative impact analyses, background values must be combined with modeled results to compare to the 1-hour NO_2 NAAQS.

Based on review of the locations of NJDEP ambient air quality monitoring sites, the closest "regional" NJDEP monitoring site were used to represent the current background NO_2 air quality in the site area. Background data for NO_2 from 2016 – 2018 was obtained from a monitoring station located in Middlesex County, New Jersey (EPA AIRData # 34-023-0011), approximately 11 km west-southwest of the Proposed Facility.

The monitor is located at the Rutgers University (Veg. Research Farm #3 on Ryders Lane) in an agricultural/rural area with proximate commercial uses (i.e., Route 1 and Interstate 95). This monitor's close proximity to the Project site qualifies it to be representative of the ambient air quality within the project area.

It should be noted that the 2017 – 2019 time period was initially examined. However, due to poor data capture in 2019 per review of the NJDEP provided data for the monitoring station, this year was not used. Therefore, the time period of 2016 – 2018 was used. Seasonal data availability for NO_2 at Rutgers University from 2016 – 2018 was as follows:

- Winter: 2016 (97.6%), 2017 (98.1%), 2018 (97.7%)
- Spring: 2016 (97.7%), 2017 (97.3%), 2018 (98.1%)
- Summer: 2016 (97.9%), 2017 (98.1%), 2018 (98.1%)
- Fall: 2016 (97.8%), 2017 (97.7%), 2018 (96.9%)

The March 1, 2011 Fox memorandum provides guidance for incorporating background concentrations in the impact assessment for the 1-hour NO2 standard.

> *"We believe that an appropriate methodology for incorporating background concentrations in the cumulative impact assessment for the 1-hour NO2 standard would be to use multiyear average of the 98th-percentile of the available background concentrations by season and hour-of-day…"*

> *"…we recommend that background values by season and hour-of-day used in the context should be based on the 3rd highest values for each season and hour of day combination…"*

This seasonal and hour of day methodology was used. The background values were first divided by season for each year. Those seasonal groups were further binned into 24-hour groups for a total of 96 bins of values (product of 4 seasons and 24 hours) for each year (2016, 2017, and 2018). The 3rd highest value from each bin was found per year. Finally, to obtain the values to be summed with the modeled concentrations, the average of those 3rd highest values was taken over three (3) years. This results in 96 values proposed to be used in the modeling analysis. The AERMOD model option (keyword BACKGROUND) was used to sum each modeled concentration with the background concentration that was calculated for that season and hour-of-day.

5.6.6 Hourly Average Background Ozone Concentrations

Based on review of the locations of NJDEP ambient air quality monitoring sites, the closest "regional" NJDEP monitoring site was used to represent the current background ozone air quality in the site area. Representative hourly average background ozone concentrations were input to AERMOD. The ozone monitors closest to the Proposed Facility site have been identified. After reviewing their locations and periods of record, a Middlesex County monitor was chosen to represent the ozone background values during the five (5) year period 2013 –

2017, concurrent with the five (5) years of surface meteorological data. This monitor is listed below.

- Middlesex County – Rutgers University (Veg. Research Farm #3), approximately 11 km west-southwest, EPA AIRData # 34-023-0011.

Ozone data availability at the Rutgers University monitor during each of the aforementioned years is as follows:

- 2013: 99%
- 2014: 98%
- 2015: 78%
- 2016: 94%
- 2017: 92%

The Rutgers University monitor was also used to represent background NO_2 concentrations. Since both datasets were used in the NO_2 air quality analysis, this monitor is preferable and appropriate to use for ozone background representation. When ozone data was missing from the Rutgers University monitor, missing hours will be substituted using the monitor hierarchy below. This hierarchy favored proximity to the Proposed Facility site, high capture rate monitors, and monitors with "general/background" or "population exposure" monitoring objectives.

- Hudson County – Bayonne, approximately 22 km away, EPA AIRData # 34-017-0006.
    - Ozone data availability at the Bayonne monitor during each of the aforementioned years is as follows:
        - 2013: 55%; 2014: 98%; 2015: 99%; 2016: 99%; 2017: 98%
- Essex County – Newark Firehouse, approximately 24 km away, EPA AIRData # 34-013-0003.
    - Ozone data availability at the Newark Firehouse monitor during each of the aforementioned years is as follows:
        - 2013: 98%; 2014: 98%; 2015: 99%; 2016: 97%; 2017: 98%
- Hunterdon County – Flemington, approximately 41 km away, EPA AIRData # 34-019-0001.
    - Ozone data availability at the Flemington monitor during each of the aforementioned years is as follows:
        - 2013: 99%; 2014: 99%; 2015: 98%; 2016: 91%; 2017: 91%
- Mercer County – Rider University, approximately 45 km away, EPA AIRData # 34-021-0005.

- Ozone data availability at the Rider University monitor during each of the aforementioned years is as follows:
    - 2013: 99%; 2014: 99%; 2015: 97%; 2016: 95%; 2017: 94%

5.6.7 Secondary Formation of PM-2.5

PM-2.5 is emitted directly from the Project emissions sources and formed in the atmosphere from Project PM-2.5 precursor emissions (NO_x and SO_2). Therefore, to account for the total air quality impact of PM-2.5, the modeled concentrations of primary PM-2.5 from the Project sources should be summed with a conservative concentration representative of PM-2.5 formed from Project PM-2.5 precursor emissions. Appropriate secondary PM-2.5 concentrations were determined based on the Project emissions and the air quality modeling results included in the U.S. EPA's Modeled Emission Rates for Precursors (MERPs) guidance (April 30, 2019), as described in the following paragraphs.

For the 24-hour averaging period, the PM-2.5 impacts from secondary formation were based on the daily 24-hour impact from a hypothetical NO_x source and a hypothetical SO_2 source that were identified from multiple model simulation results contained in the U.S. EPA MERPs guidance. For NO_x, the eastern US (EUS) hypothetical source located at Bronx County, New York (source #5) with a surface release (L), annual NO_x emissions of 500 tons per year (tpy), and a maximum impact of 0.02 $\mu g/m^3$ was used.

Data showing the effects of primary NOx and SOx gaseous releases on secondary particulate formation downwind from a hypothetical source located in the Bronx, in the Greater New York area, were obtained from U.S. EPA (https://www.epa.gov/scram/merps-view-qlik). The Bronx hypothetical source is in an urban area within the Greater New York City area (the Bronx) and is the most representative of secondary formation expected from the facility compared to other available hypothetical sources in the Eastern U.S.

The Bronx, NY source is located approximately 48 km to the northeast of the facility in an area that is proximate to urban levels of air pollution due to industrial, commercial, and mobile sources of air pollution within the Greater New York City area. The next closest hypothetical source to the proposed project site is located in Warren, NJ at a distance of approximately 80 km to the northwest. This source is located in a rural area with significantly lower levels of industrial, commercial, and mobile source air emissions than the proposed project site. In addition, the base elevation and meteorological conditions at the Bronx, NY source location are more representative of the Project site than the conditions at the Warren, NJ source. The Bronx, NY source is located at 65 feet above MSL with proximity to the Atlantic Ocean influences while the Warren, NJ source location is located at 843 feet above MSL in elevated terrain without the influences of the Atlantic Ocean on the local meteorological conditions.

The proposed facility site is located along the northwestern edge of the Atlantic Coastal Plain Province in New Jersey, and the elevation of the proposed facility site is approximately 22.5 feet above MSL. The topography in the immediate area is generally flat, with elevations at sea level on the Raritan River and elevations rising upwards of and exceeding 200 feet in Fords, New Jersey. As such, the meteorological conditions, base elevation, regional emissions, and background concentrations at the Bronx, NY source location are the most representative of the proposed facility site for the hypothetical sources provided by U.S. EPA.

Therefore, the estimated impact on the 24-hour secondary PM-2.5 formation from the Project's (Keasbey Energy Center) NO_x emissions was determined as follows:

(143.2 tpy NO_x from Project/500 tpy NO_x) × 0.02 μg/m³ = 0.006 μg/m³ PM-2.5 concentration

The estimated impact on the 24-hour secondary PM-2.5 formation from the Project's (Keasbey Energy Center and Woodbridge Energy Center combined) NO_x emissions was determined as follows:

(291.1 tpy NO_x from Project/500 tpy NO_x) × 0.02 μg/m³ = 0.011 μg/m³ PM-2.5 concentration

For SO_2, the EUS hypothetical source located at Bronx County, New York (source #5) with a surface release (L), annual SO_2 emissions of 500 tpy, and a maximum impact of 0.15 μg/m³ was used. Therefore, the estimated impact on the 24-hour secondary PM-2.5 formation from the Project's (Keasbey Energy Center) SO_2 emissions was determined as follows:

(40.5 tpy SO_2 from Project/500 tpy SO_2) × 0.15 μg/m³ = 0.0125 μg/m³ PM-2.5 concentration

The estimated impact on the 24-hour secondary PM-2.5 formation from the Project's (Keasbey Energy Center and Woodbridge Energy Center combined) SO_2 emissions was determined as follows:

(51.7 tpy SO_2 from Project/500 tpy SO_2) × 0.15 μg/m³ = 0.0155 μg/m³ PM-2.5 concentration

As a result, the estimated total impact on the 24-hour secondary PM-2.5 formation is based on the combined concentrations from NO_x and SO_2 secondary formation. This concentration of 0.019 ug/m³ was added to the Keasbey Energy Center 24-hour PM-2.5 model results in order to accurately capture the total PM-2.5 impacts from the Project. The concentration of 0.027 ug/m³ was added to the Keasbey Energy Center and Woodbridge Energy center combined 24-hour PM-2.5 model results in order to accurately capture the total PM-2.5 impacts from the Project.

For the annual averaging period, this analysis was based on the annual average impact from a hypothetical NO_x source and a hypothetical SO_2 source that were identified from multiple model simulation results contained in the U.S. EPA MERPs guidance. For NO_x, the eastern US (EUS) hypothetical source located at Bronx County, New York (source #5) with a surface release (L), annual NO_x emissions of 500 tpy, and a maximum impact of 0.001 μg/m³ was used. Therefore, the estimated impact on the annual secondary PM-2.5 formation from the Project's (Keasbey Energy Center) NO_x emissions was determined as follows:

(143.2 tpy NO_x from Project/500 tpy NO_x) × 0.001 μg/m³ = 0.0003 μg/m³ PM-2.5 concentration

The estimated impact on the annual secondary PM-2.5 formation from the Project's (Keasbey Energy Center and Woodbridge Energy Center combined) NO_x emissions was determined as follows:

(291.1 tpy NO_x from Project/500 tpy NO_x) × 0.001 μg/m³ = 0.0006 μg/m³ PM-2.5 concentration

For SO_2, the EUS hypothetical source located at Bronx County, New York (source #5) with a surface release (L), annual SO_2 emissions of 500 tpy, and a maximum impact of 0.008 μg/m³ was used. Therefore, the estimated impact on the annual secondary PM-2.5 formation from the Project's (Keasbey Energy Center) SO_2 emissions was determined as follows:

(40.5 tpy SO_2 from Project/500 tpy SO_2) × 0.008 μg/m³ = 0.0006 μg/m³ PM-2.5 concentration

The estimated impact on the annual secondary PM-2.5 formation from the Project's (Keasbey Energy Center and Woodbridge Energy Center combined) SO_2 emissions was determined as follows:

(51.7 tpy SO_2 from Project/500 tpy SO_2) × 0.008 μg/m³ = 0.0008 μg/m³ PM-2.5 concentration

As a result, the estimated total impact on the annual secondary PM-2.5 formation is based on the combined concentrations from NO_x and SO_2 secondary formation. This concentration of 0.0009 ug/m³ was added to the Keasbey Energy Center annual PM-2.5 model results in order to accurately capture the total PM-2.5 impacts from the Project. The concentration of 0.0014 ug/m³ was added to the Keasbey Energy Center and Woodbridge Energy center combined annual PM-2.5 model results in order to accurately capture the total PM-2.5 impacts from the Project.

5.6.8 Combustion Turbine Load Screening Modeling Analysis (Keasbey Energy Center)

To determine the worst case operating scenarios for the proposed combustion turbine at the Keasbey Energy Center, a detailed load screening analysis was performed. As previously discussed, sixteen (16) combinations of load conditions and ambient operating temperatures were calculated. The turbine load screening analysis results can be found in Table 5-17.

Of the sixteen (16) operating scenarios previously described for the Keasbey Energy Center, the worst case operating scenarios (i.e., operating scenarios which yielded the maximum modeled concentrations) were:

- Case 11 (all pollutants and averaging periods)

For the purposes of conducting the load screening analysis, gas firing was assumed to occur for 8,760 hours (i.e., the most gas firing hours possible in one year). When the annual facility modeling was conducted (and as noted in the modeling input file comments), combustion turbine gas firing was assumed to occur for 8,760 hours.

5.6.9 Combustion Turbine Load Screening Modeling Analysis (Woodbridge Energy Center)

To determine the worst case operating scenarios for the existing combustion turbines at the Woodbridge Energy Center, a detailed load screening analysis was performed. As previously discussed, fourteen (14) combinations of load conditions and ambient operating temperatures were calculated. The turbine load screening analysis results can be found in Table 5-18.

Of the fourteen (14) operating scenarios previously described for the Woodbridge Energy Center, the worst case operating scenarios (i.e., operating scenarios which yielded the maximum modeled concentrations) were:

- Case 4 (8-hour CO and 24-hour SO_2);
- Case 7 (1-hour CO, 1-hour and 3-hour SO_2, and, 1-hour NO_2); and,
- Case 9 (24-hour PM-10, annual NO_2, annual PM-10, annual SO_2, 24-hour PM-2.5, and annual PM-2.5)

When the annual facility modeling was conducted (and as noted in the modeling input file comments), combustion turbine gas firing was assumed to occur for 8,760 hours.

5.6.10 Start-Up and Shutdown Scenarios (Keasbey Energy Center)

Startup is a short-term, transitional mode of operation for the combined cycle unit. In combined cycle operation, where the exhaust gases are directed through a HRSG to produce steam for a steam turbine generator, additional startup time is necessary in order to reduce thermal shock and excessive wear in both the HRSG and the steam turbine. Emission rates of some pollutants may be higher during startup operations because emissions controls may not become fully effective until a minimum threshold operating load and/or control device temperature is attained. The need for additional modeling to account for predicted short-term project impacts during startup of the combined cycle unit was assessed for criteria pollutants for which a short-term NAAQS or PSD increment has been defined. Furthermore, in order to facilitate startup of the CTG and steam turbine generator, as well as for maintenance purposes, the auxiliary boiler was modeled as operating simultaneously with the combustion turbine. The GE 7HA.02 combustion turbine can startup in a rapid response mode, which takes less time than a conventional start. The basic approach for rapid response mode is to thermodynamically decouple the gas turbine from the bottoming cycle, thereby allowing the gas turbine to start without the hold times needed to allow the HRSG and steam turbine to heat up. In other words, the rapid response start allows the plant to startup significantly faster than a conventional combined cycle plant by decoupling the steam turbine as the gas turbine ramps up and comes online.

A gas-fired rapid start requires 60 minutes. The combustion turbine also requires a 30 minute shutdown period. Startup emissions and associated stack parameters for the natural gas rapid response scenario for the proposed Keasbey Energy Center have been estimated based on vendor data and are shown in Table 5-19. During the operational year, CPV Keasbey, LLC is proposing 262 gas fired rapid starts. Gas fired rapid starts were evaluated for the requisite averaging periods for CO, NO_2, SO_2, PM-10, and PM-2.5.

Because the startup/shutdown durations will be shorter than some of the averaging periods modeled, the modeled concentrations for these averaging periods that extend beyond the start-up duration were determined based on the combination of the startup conditions for the appropriate amount of time and the worst case pollutant and averaging period specific operating scenario determined in the combustion turbine load analysis.

A description of the worst case modeling scenarios for 1-hour NO_2 natural gas startup for the Keasbey Energy Center is as follows:

NG start = 250.7 lb/hr (31.59 g/s) over 1 hour.

NG “Shutdown” = 17.5 lb/hr (2.21 g/s) over 30 minutes.
“Case11sd” (worst case gas fired operating scenario) = 3.80 g/s ▪ (30 min/60 min) = 1.90 g/s for remaining 30 minutes.

A description of the worst case modeling scenarios for 1-hour CO natural gas startup for the Keasbey Energy Center is as follows:

NG start = 225.3 lb/hr (28.39 g/s) over 1 hour.

NG "Shutdown" = 312.5 lb/hr (39.38 g/s) over 30 minutes.
"Case11sd" (worst case gas fired operating scenario) = 2.31 g/s ▪ (30 min/60 min) = 1.16 g/s for remaining 30 minutes.

A description of the worst case modeling scenarios for 8-hour CO natural gas startup for the Keasbey Energy Center is as follows:

NG start = 225.3 lb/8 hrs = 3.55 g/s over 1 hour.
"Case11c" (worst case gas fired operating scenario) = 2.31 g/s ▪ (7 hrs/8 hrs) = 2.02 g/s for remaining 7 hours.

NG "Shutdown" = 312.5 lb/8 hrs = 4.92 g/s per turbine over 0.50 hours.
"Case11sd" (worst case gas fired operating scenario) = 2.31 g/s ▪ (7.5 hrs/8 hrs) = 2.17 g/s for remaining 7.5 hours.

A description of the worst case modeling scenarios for 1-hour SO_2 natural gas startup for the Keasbey Energy Center is as follows:

NG start = 3.00 lb/hr = 0.38 g/s over 1-hour.

NG "Shutdown" = 0.73 lb/hr = 0.09 g/s over 30 minutes.
"Case11ks" (worst case gas fired operating scenario) = 1.11 g/s ▪ (30 min/60 min) = 0.56 g/s for remaining 30 minutes.

A description of the worst case modeling scenarios for 3-hour SO_2 natural gas startup for the Keasbey Energy Center is as follows:

NG start = 3 lbs/3 hrs = 0.13 g/s over 1 hour.
"Case11c" (worst case gas fired operating scenario) = 1.11 g/s ▪ (2 hrs/3 hrs) = 0.74 g/s for remaining 2 hrs.

NG "Shutdown" = 0.73 lbs/3 hrs =0.03 g/s over 0.5 hours.
"Case11ks" (worst case gas fired operating scenario) = 1.11 g/s ▪ (2.5 hrs/3 hrs) = 0.93 g/s for remaining 2.5 hours.

A description of the worst case modeling scenarios for 24-hour SO_2 natural gas startup for the Keasbey Energy Center is as follows:

NG start = 3 lbs/24 hrs =0.016 g/s over 1 hour.
"Case11c" (worst case gas fired operating scenario) = 1.11 g/s ▪ (23 hrs/24 hrs) = 1.06 g/s for remaining 23 hrs.

NG "Shutdown" = 0.73 lbs/24 hrs = 0.004 g/s over 0.5 hours.
"Case11sd" (worst case gas fired operating scenario) = 1.11 g/s ▪ (23.5 hrs/24 hrs) = 1.09 g/s for remaining 23.5 hours.

A description of the worst case modeling scenarios for 24-hour PM-10 and PM-2.5 natural gas startup for the Keasbey Energy Center is as follows:

NG start = 10.4 lbs/24 hrs = 0.055 g/s over 1 hour.
"Case11c" (worst case gas fired operating scenario) = 2.98 g/s ▪ (23 hrs/24 hrs) = 2.86 g/s for remaining 23 hrs.

NG "Shutdown" = 5.3 lbs/24 hrs = 0.028 g/s over 0.5 hours.
"Case11sd" (worst case gas fired operating scenario) = 2.98 g/s ▪ (23.5 hrs/24 hrs) = 2.92 g/s for remaining 23.5 hours.

A summary table presenting the emissions for the Keasbey Energy Center startup and shutdown modeling methodology is included as Table 5-20.

5.6.11 Start-Up and Shutdown Scenarios (Woodbridge Energy Center)

For the existing Woodbridge Energy Center, startups are defined in the permit as "the period of time from initiation of combustion turbine operation until it achieves steady-state emissions compliance, less than or equal to 3.4 hours". Further, shutdowns are defined in the permit as "the period of time from initiation of lowering combustion turbine power output with the intent to cease generation of electrical output and concludes with the cessation of the combustion turbine operation, less than or equal to 30 minutes".

Permitted startup and shutdown emissions and associated stack parameters for the existing Woodbridge Energy Center are shown in Table 5-21.

Because the shutdown duration is shorter than the averaging periods modeled, the modeled concentrations for these averaging periods that extend beyond the start-up duration were determined based on the combination of the shutdown conditions for the appropriate amount of time and the worst-case pollutant-and averaging period-specific operating scenario determined in the combustion turbine load analysis.

A description of the worst case modeling scenarios for 1-hour NO_2 natural gas startup for the Woodbridge Energy Center is as follows:

NG start = 112 lb/hr (14.11 g/s) for turbine “a” over 3.4 hours.
“Startbw” (worst case gas fired operating scenario) = 2.31 g/s ▪ (60 min/60 min) = 2.31 g/s for turbine “b”.

NG “Shutdown” = 68.5 lb/hr (8.63 g/s) per turbine over 30 minutes.
“Case7sd” (worst case gas fired operating scenario) = 2.31 g/s ▪ (30 min/60 min) = 1.16 g/s per turbine for remaining 30 minutes.

A description of the worst case modeling scenarios for 1-hour CO natural gas startup for the Woodbridge Energy Center is as follows:

NG start = 941 lb/hr (118.57 g/s) per turbine over 3.4 hours.

NG “Shutdown” = 618.4 lb/hr (77.92 g/s) per turbine over 30 minutes.
“Case7sd” (worst case gas fired operating scenario) = 1.41 g/s ▪ (30 min/60 min) = 0.71 g/s per turbine for remaining 30 minutes.

A description of the worst case modeling scenarios for 8-hour CO natural gas startup for the Woodbridge Energy Center is as follows:

NG start = 941 lb/hr ▪ (3.4 hrs/8 hrs) ▪ (0.126 g/s / lb/hr) = 50.39 g/s per turbine.
“Case4su” (worst case gas fired operating scenario) = 0.82 g/s ▪ (4.6 hrs/8 hrs) = 0.47 g/s per turbine for remaining 4.6 hours.

It should be noted that although startup emissions account for only 3.4 hours of the 8-hour averaging period, 50.39 g/s of CO was modeled for each hour to represent a startup emission rate over the 8-hour period, and a CO emission rate of 0.47 g/s was modeled for each hour to represent operation of the turbine under steady-state conditions for the remaining 4.6 hours of the 8-hour averaging period for CO.

NG “Shutdown” = 618.4 lb/hr ▪ (0.5 hrs/8 hrs) ▪ (0.126 g/s / lb/hr) = 4.87 g/s per turbine.

"Case4sd" (worst case gas fired operating scenario) = 0.82 g/s ▪ (7.5 hrs/8 hrs) = 0.77 g/s per turbine for remaining 7.5 hours.

A description of the worst case modeling scenarios for 1-hour SO_2 natural gas startup for the Woodbridge Energy Center is as follows:

NG start = 2.6 lb/hr (0.33 g/s) per turbine over 3.4 hours.

NG "Shutdown" = 2.6 lb/hr (0.33 g/s) per turbine over 30 minutes.
"Case7sd" (worst case gas fired operating scenario) = 0.57 g/s ▪ (30 min/60 min) = 0.29 g/s per turbine for remaining 30 minutes.

A description of the worst case modeling scenarios for 3-hour SO_2 natural gas startup for the Woodbridge Energy Center is as follows:

NG start = 2.6 lb/hr (0.33 g/s) per turbine over 3.4 hours.

NG "Shutdown" = 2.6 lb/3 hrs (0.11 g/s) over 0.5 hours.
"Case7sd" (worst case gas fired operating scenario) = 0.57 g/s ▪ (2.5 hrs/3 hrs) = 0.48 g/s per turbine for remaining 2.5 hours.

A description of the worst case modeling scenarios for 24-hour SO_2 natural gas startup for the Woodbridge Energy Center is as follows:

NG start = 2.6 lb/hr ▪ (3.4 hrs/24 hrs) ▪ (0.126 g/s / lb/hr) = 0.05 g/s per turbine.
"Case4su" (worst case gas fired operating scenario) = 0.33 g/s ▪ (20.6 hrs/24 hrs) = 0.28 g/s per turbine for remaining 20.6 hours.

NG "Shutdown" = 2.6 lb/hr ▪ (0.5 hrs/24 hrs) ▪ (0.126 g/s / lb/hr) = 0.007 g/s per turbine.
"Case4sd" (worst case gas fired operating scenario) = 0.33 g/s ▪ (23.5 hrs/24 hrs) = 0.32 g/s per turbine for remaining 23.5 hours.

A summary table presenting the emissions for the Woodbridge Energy Center startup and shutdown modeling methodology is included as Table 5-22.

5.6.12 Combined Startups/Shutdowns (Keasbey Energy Center and Woodbridge Energy Center)

During the operational year, CPV Keasbey, LLC is proposing 262 natural gas fired rapid starts. Woodbridge Energy Center's existing permit does not place limits on the number or types of startups and shutdowns that can occur.

For the purposes of this modeling analysis, the following was used to evaluate the combined startups and shutdowns at Keasbey and Woodbridge:

- Natural gas fired startups and shutdowns at Keasbey and the permitted startups and shutdowns at Woodbridge.

Note that the startup modeling for 1-hour NO_2 included simultaneous operation of one (1) existing combustion turbine, auxiliary boiler, and emergency equipment at Woodbridge Energy Center as well as the proposed combustion turbine, auxiliary boiler, and emergency equipment at Keasbey Energy Center. As discussed in Section 5.7 of the Keasbey Energy Center Air Quality Modeling Protocol, the U.S. EPA guidance (September 30, 2014 and March 1, 2011 guidance memorandums, respectively) indicates that intermittent operations such as startup scenarios are to be treated differently than normal operations. The guidance recommends that "...compliance demonstrations for the 1-hour NO_2 NAAQS can be limited to those emissions that are continuous enough or frequent enough to contribute significantly to the annual distribution of daily maximum 1-hour concentrations". Based on U.S. EPA guidance, excluding startup/shutdown emissions from consideration, on the basis that they are intermittent, is acceptable if the emissions are infrequent enough so that they would not be expected to affect the daily max 1-hour emissions more than 7 calendar days per year, since the form of the standard is the 8th highest daily max. It is expected that rarely the two (2) combustion turbines at the Woodbridge Energy Center and the proposed combustion turbine at the Keasbey Energy Center would startup in the same hour. Thus, it is expected that startup operation of all three combustion turbines within the same hour will occur less than 8 days per year. As such, the 1-hour NO_2 modeling analysis did not include an operating scenario with simultaneous startup operation of the two (2) combustion turbines at the Woodbridge Energy Center and the proposed combustion turbine at the Keasbey Energy Center as these events are intermittent per U.S. EPA guidance.

This operating scenario can be included in the operating permit with a permit condition as shown below that indicates that the Keasbey Energy Center startup scenario cannot occur simultaneously with Woodbridge Energy Center startup of both combustion turbines for more than 7 days per year.

Draft permit condition:

The KEC OS4 E201 Firing NG - Rapid Response Start-Up cannot occur simultaneously more than 7 days per year with the combined WEC OS3 Turbine 1 Start-up Operation and OS7 Turbine 2 Start-up Operation. [N.J.A.C. 7:27-22.8(b)(3)]

5.6.13 Annual Modeling Analysis

Annual modeling for the facility was accomplished by assessing the total facility emissions using the worst case combustion turbine modeling condition for the Woodbridge Energy Center and Keasbey Energy Center, respectively. Table 5-23 provides a summary of the annual emissions used in the annual modeling which include both the steady state (normal operation) emissions plus the startup and shutdown emissions.

5.6.14 Startup/Shutdown Modeling Analysis

The results of the startup/shutdown modeling analysis are summarized in Table 5-24 for the total combined concentrations of both facilities. Likewise, the maximum modeled impacts are compared to the NAAQS/NJAAQS in Table 5-25. As shown in Table 5-24, the maximum modeled combined facility concentrations resulting from startups/shutdowns exceed the applicable SICs for 1-hour NO_2, annual NO_2, annual PM-2.5, 24-hour PM-10, and 24-hour PM-2.5. Additionally, none of the pollutants, when combined with a representative background concentration, exceed any applicable NAAQS/NJAAQS (see Table 5-25). Note that the startup/shutdown modeling included simultaneous operation of the two existing combustion turbines, auxiliary boiler, and emergency equipment at Woodbridge Energy Center as well as the proposed combustion turbine, auxiliary boiler, and emergency equipment at Keasbey Energy Center. It should be noted that modeling results for Keasbey Energy Center and Woodbridge Energy Center as independent operations can be found in Appendix J.

5.6.15 Maximum Modeled Facility Concentrations

Table 5-26 presents the maximum modeled air quality concentrations during normal operations as calculated by AERMOD for the total combined concentrations of both facilities. Likewise, for these facilities the maximum modeled normal operations impacts are compared to the NAAQS/NJAAQS in Table 5-27. As shown in Table 5-26, the maximum concentrations for the combined facilities exceed the applicable SICs for 1-hour and annual NO_2, 24-hour PM-10, 24-hour PM-2.5, and annual PM-2.5. Further, Table 5-27 shows that none of the pollutants, when combined with a representative background concentration, exceed any applicable NAAQS/NJAAQS.

Under longstanding U.S. EPA guidance and interpretations, the SICs are used to determine if a source makes or could make a significant contribution to a predicted violation of a NAAQS or

PSD increment. If a source is predicted to have maximum impacts that are below the SICs, then a cumulative (or "full") impact analysis that includes other facilities is not required, and the impacts of the project are considered to be *de minimis* or insignificant. By showing that maximum predicted Project impacts will be below the corresponding SICs for CO and SO_2, the Project is exempt from the requirement to conduct any additional analyses to demonstrate compliance with the NAAQS for these pollutants.

5.6.16 Area of Impact Determination

Under PSD regulations, an air quality dispersion modeling analysis is required to ensure that CO, PM-10, PM-2.5, SO_2, and NO_2 emissions from the proposed facility will be compliant with NAAQS and applicable PSD increments. Note that per U.S. EPA PM-2.5 modeling guidance, the emissions of PM-2.5 should account for NO_2 and SO_2 precursor emissions (U.S. EPA, 2013).

Concentrations of 24-hour PM-10, 24-hour PM-2.5, 1-hour NO_2, annual NO_2, and annual PM-2.5 have been determined to be significant. Therefore, they are the only pollutants/averaging periods determined to have an area of impact (AOI), thus requiring additional impact assessments.

The areas of impact for the aforementioned pollutants under normal operations are as follows:

- 24-hour PM-10 AOI = 897 meters;
- 24-hour PM-2.5 AOI = 2,160 meters;
- 1-hour NO_2 AOI = 1,266 meters;
- Annual NO_2 AOI = 266 meters; and
- Annual PM-2.5 AOI = 764 meters.

Table 5-28 summarizes the normal operations information above by providing the pollutant, averaging time, SIL, maximum modeled concentration, and area of impact.

The areas of impact for the aforementioned pollutants under startup/shutdown operations are as follows:

- 24-hour PM-10 AOI = 897 meters;
- 24-hour PM-2.5 AOI = 2,598 meters;
- 1-hour NO_2 AOI = 50,000 meters;
- Annual NO_2 AOI = 266 meters; and
- Annual PM-2.5 AOI = 809 meters.

Table 5-29 summarizes the startup/shutdown operations information above by providing the pollutant, averaging time, SIL, maximum modeled concentration, and area of impact.

The additional impact assessment required for these pollutants and averaging periods is a multiple source NAAQS and PSD Class II increment modeling assessment. A multisource air quality modeling protocol will be submitted under separate cover for approval by the NJDEP after a list of offsite sources to be included in the NAAQS analyses is provided by the NJDEP. The multisource protocol will discuss the applicable modeling methodology to be used in the NAAQS and PSD Class II increment analyses along with appropriate offsite source emissions.

5.7 Class I Impacts

The only Class I area within 300 km of the proposed facility is the Brigantine Wilderness area in New Jersey. This area is located approximately 108 km south of the proposed facility. The Federal Land Manager (FLM) for this Class I area was notified on July 12, 2016 to determine if assessments of impacts in the Class I area would be required. The FLM has reviewed the proposed facility's details and related correspondence and has confirmed in a July 13, 2016 email that a Class I AQRV analysis for the proposed facility is not required (see Appendix A of the Air Quality Modeling Protocol). However, at the Department's request, the applicant re-contacted the FLM of the combined emissions of the proposed Keasbey Energy Center and the existing Woodbridge Energy Center. The FLM has reviewed the revised submittal and has confirmed in a December 13, 2016 email that a Class I AQRV analysis for the proposed facility is not required (see Appendix D).

Air quality concentrations of NO_x, SO_2, and PM-10/PM-2.5 in the Brigantine Wilderness Area were determined using the AERMOD model. Class I screening receptors were developed first by placing a ring of receptors at 50 kilometers from the Facility site. Actual Class I receptors and heights for the Brigantine Wilderness Area were obtained from the National Park Service. Screening receptors (50-kilometers from the Facility) within an arc subtended by the minimum and maximum angular directions to the Brigantine Wilderness Area were assigned all of the heights within that Class I area in order to develop a set of representative screening receptors at 50 kilometers. Maximum concentrations were then compared to the PSD Class I SILs and increments for the total concentrations of the combined facilities and can be found in Table 5-30.

The results of the modeling indicate that the combined facility impacts are lower than the PSD Class I SILs and increments for all pollutants and averaging periods. It should be noted that the modeling results are highly conservative since they reflect the concentrations at a distance of 50 kilometers from the Facility rather than the nearest Class I area that is actually at a distance of approximately 108 km. Furthermore, it should be noted that modeling was performed at a distance of 50 kilometers based upon the spatial limitations of the AERMOD model.

5.8 NJDEP Ambient Air Quality Standards Analysis

The NJAAQS are presented in Table 5-31. The maximum modeled concentrations for normal operation are presented in Table 5-32 for the total concentrations of the combined facilities. As shown in Table 5-32, the combined facility impacts, plus background, do not exceed or threaten to exceed the NJAAQS.

5.9 Graphical Presentation of Maximum Concentrations relative to SILs

The maximum concentrations and associated SILs are presented graphically on satellite imagery for the study area around the facility site. The concentrations represent the total combined impacts from both the CPV Keasbey and CPV Shore (Woodbridge Energy Center) emission units. The locations of maximum concentrations and the distribution of concentrations are depicted on the following figures.

- Figure 5-9: 24-Hour PM-10 Maximum Modeled Concentration Isopleths (ug/m^3) – Normal Operations
- Figure 5-10: 24-Hour PM-2.5 Maximum Modeled Concentration Isopleths (ug/m^3) – Normal Operations
- Figure 5-11: 1-Hour NO_2 Maximum Modeled Concentration Isopleths (ug/m^3) – Normal Operations
- Figure 5-12: Annual NO_2 Maximum Modeled Concentration Isopleths (ug/m^3) – Normal Operations
- Figure 5-13: Annual PM-2.5 Maximum Modeled Concentration Isopleths (ug/m^3) – Normal Operations
- Figure 5-14: 24-Hour PM-10 Maximum Modeled Concentration Isopleths (ug/m^3) – Includes SUSD Operations
- Figure 5-15: 24-Hour PM-2.5 Maximum Modeled Concentration Isopleths (ug/m^3) – Includes SUSD Operations
- Figure 5-16: 1-Hour NO_2 Maximum Modeled Concentration Isopleths (ug/m^3) – Includes SUSD Operations
- Figure 5-17: Annual NO_2 Maximum Modeled Concentration Isopleths (ug/m^3) – Includes SUSD Operations
- Figure 5-18: Annual PM-2.5 Maximum Modeled Concentration Isopleths (ug/m^3) – Includes SUSD Operations

The following figures represent the maximum concentrations and comparison to SILs for the combined operation of the CPV Keasbey and CPV Woodbridge facilities during normal operations conditions. Figure 5-9 illustrates the maximum PM-10 concentration of 9.6 ug/m^3 with associated contours indicating the significant impact level of 5 ug/m^3. As shown, the maximum concentration occurs immediately off the property, with the three areas of impacts are located a few hundred meters, east, southeast and southwest of the site. The maximum area of impact (AOI) is 897 meters.

Figure 5-10 illustrates the maximum 24-hour PM-2.5 concentration of 7.4 ug/m^3 with associated contours indicating the significant impact level of 1.2 ug/m^3. The maximum concentration occurs immediately on the property line, with the area of impact extending beyond 2 kilometers around the facility site. The larger area of impact for PM-2.5 relative to PM-10 is predominantly due to the much lower SIL of 1.2 ug/m^3 as compared to 5 ug/m^3 for PM-10. The AOI is 2,160 meters.

Figure 5-11 illustrates the maximum 1-hour NO_2 concentration of 23.1 ug/m^3 under normal operation of the combustion turbines and ancillary equipment with associated contours indicating the significant impact level of 7.5 ug/m^3. As shown, the maximum concentration occurs immediately off the property towards the southwest, with the area of impact as two lobes east and west of the site. The significant concentrations extend about one kilometer to the east and west. The AOI is 1,266 meters.

Figure 5-12 illustrates the maximum annual NO_2 concentration of 1.3 ug/m^3 under normal operation of the combustion turbines and ancillary equipment. The maximum concentration occurs on the property line, and only 1 receptor exceeded the significant impact level of 1 ug/m^3. There are insufficient receptors to produce a valid contour level for the SIL.

Figure 5-13 illustrates the maximum annual PM-2.5 concentration of 0.4 ug/m^3 under normal operation of the combustion turbines and ancillary equipment. The maximum concentration occurs a few hundred meters southeast of the facility. A contour of the significant impact level of 0.3 ug/m^3 is depicted around the maximum and extends about a half kilometer towards the southeast of the facility. The AOI is 764 meters.

The following figures represent the maximum concentrations and comparison to SILs for combined operation of the CPV Keasbey and CPV Woodbridge facilities during and including startup and shutdown conditions. The reader should note that the results presented are extremely conservative in the respect that the modeling methodology assumes that the three combustion turbines and two auxiliary boilers will experience a simultaneous start for every hour for the five-year period of meteorology, with the exception of 1-hour NO2 modeling as discussed earlier. In reality, this will be impossible to occur during actual operation, since it does not reflect the downtime associated with the facilities.

Figure 5-14 illustrates the maximum PM-10 concentration of 9.6 ug/m^3 with associated contours indicating the significant impact level of 5 ug/m^3. As shown, the maximum concentration occurs immediately off the property, with the three areas of impacts are located a few hundred meters, east, southeast, and southwest of the site. This figure is nearly identical to Figure 5-9, with the AOI at 897 meters.

Figure 5-15 illustrates the maximum 24-hour PM-2.5 concentration of 7.4 ug/m^3 with associated contour indicating the significant impact level of 1.2 ug/m^3. The maximum concentration occurs immediately on the property line, with the area of impact extending just short of 3 kilometers around the facility site. The larger area of impact for PM-2.5 relative to PM-10 is predominantly due to the much lower SIL of 1.2 ug/m^3 as compared to 5 ug/m^3 for PM-10. This figure is similar to Figure 5-10 with a slightly larger AOI of 2,598 meters.

Figure 5-16 illustrates the maximum 1-hour NO_2 concentration of 74.4 ug/m^3 under startup conditions of the combustion turbines and ancillary equipment with associated contours indicating the significant impact level of 7.5 ug/m^3. As shown, the maximum concentration occurs at a distance of approximately 0.6 kilometers towards the northeast of the facility. The associated significant impact area for 1-hour NO_2 concentrations during facility startup conditions extends to 50 kilometers, which is the extent of the AERMOD modeling receptors.

Figure 5-17 illustrates the maximum annual NO_2 concentration of 1.3 ug/m^3 including startup operations and includes the startup emissions of the combustion turbines and ancillary equipment. The maximum concentration occurs on the property line and only 1 receptor exceeded the significant impact level of 1.0 ug/m^3. There are insufficient receptors to produce a valid contour level for the SIL.

Figure 5-18 illustrates the maximum annual PM-2.5 concentration of 0.4 ug/m^3 including startup conditions of the combustion turbines and ancillary equipment. The maximum concentration occurs a few hundred meters east of the facility. A contour of the significant impact level of 0.3 ug/m^3 is depicted around the maximum and extends about a half kilometer towards the southeast of the facility. This figure is essentially identical to Figure 5-13 with the AOI at 809 meters.

5.10 NJDEP Air Toxics Risk Analysis

The receptor-point concentrations of toxic substances identified by the NJDEP as Hazardous Air Pollutants (HAP) that could potentially be emitted by a piece of equipment from the existing Woodbridge and proposed Keasbey facilities (and that also exceeded a NJDEP Reporting Threshold) were assessed in order to evaluate the potential health risk to the public beyond the property line of the facilities. This was done by considering each individual HAP emission that contributes to the evaluation as well as by considering the cumulative effects of the HAPs that contribute to the evaluation for the total facility.

To assess the potential for offsite public health threats, the NJDEP Technical Manual 1003: Guidance on Preparing a Risk Assessment for Air Contaminant Emissions (Revised) (NJDEP, 2018) was used. The NJDEP has prescribed and provided a methodology to ascertain the potential health effects from facilities seeking permits to emit air toxics. The modeling methodology for assessment used the maximum (worst case) short term emissions (in lb/hr) and annual emissions (in tons/year) with the worst case combustion turbine short term and annual operating cases as determined by the worst case scenarios identified for the criteria pollutants. Only the combustion turbines that have specified permit limits are included in the risk assessment. The auxiliary boilers, emergency diesel generators, and emergency diesel fire pumps do not have air toxics emissions above reportable thresholds.

In order to provide the most conservative calculation for the Air Toxics Risk Assessment, the maximum air toxics emission rates are based on the highest heat input of the combustion turbine, recognizing that the calculation method is based on AP-42 air emission factors times the heat input. The highest air toxics emission rates are used with the worst case combustion turbine scenarios identified for the criteria pollutants. The worst case combustion turbine scenarios identified for the criteria pollutants are presented in Sections 5.6.4 and 5.6.5. For Keasbey Energy Center, these worst case operating conditions are represented by case 11 (1-hour, 24-hour and annual), respectively. For Woodbridge Energy Center, these worst case operating conditions are represented by case 7 (1-hour) and case 9 (24-hour and annual), respectively.

The 1-hour and annual concentrations from the Woodbridge Energy Center as well as the proposed Keasbey Energy Center were determined by modeling the air toxic emission rates found in Table 5-33. Maximum modeled 1-hour and annual concentrations were compared to the reference concentrations and unit risk factors identified in Technical Manual 1003 and risk screening worksheet. The total facility cumulative risk for all applicable air toxic emissions are presented in Table 5-34. It should be noted that benzo(a)pyrene emissions include emissions of all pollutants listed as "polycyclic organic matter" and that lead was modeled for a 24-hour averaging period. The worst-case modeling parameters used for each piece of equipment/averaging period combination for this analysis are included in Table 5-33a.

As demonstrated in Table 5-34, the cumulative risk from the emissions from the permitted air toxic emissions are below the risk thresholds and are negligible. For Long-Term Carcinogenic and Non-carcinogenic Effects and Short-Term Effects, the long-term Cancer Risk for each individual HAP is less than 10 in a million (1.00E-5). Further, the long-term Cancer Risk for the cumulative effects of all the HAPs (8.1E-7) is also less than 10 in a million (1.00E-5). Total facility-wide cancer risk that is less than or equal to 10 in a million is considered negligible. The same is true for the long-term and short-term indices. The long-term index for each individual HAP is less than one and the long-term Hazard Index for the cumulative effects of all the HAPs (6.7E-2) is less than one. Further, the short-term index for each individual HAP is less than one and the short-term Hazard Index for the cumulative effects of all the HAPs (4.6E-2) is less than one. Based up on the above determinations, since the hazard quotients for each non-carcinogen is less than or equal to one, the risk from the total facility is considered negligible.
In the case of lead, it is also worth noting that the rolling 3-month period maximum was conservatively estimated from the maximum modeled 24-hour concentration to be 0.00108 $\mu g/m^3$, and substantially lower than the 0.15 $\mu g/m^3$ lead NAAQS.

5.11 PSD Additional Impacts Analyses

5.11.1 Impacts to Soil and Vegetation

A component of the PSD review includes an analysis to determine the potential air quality impacts on sensitive vegetation types that may be present in the vicinity of the proposed facility. The evaluation of potential impacts on vegetation was conducted in accordance with "A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals" (U.S. EPA, 1980). Calculated emission concentrations of various constituents from the proposed and existing facilities were added to ambient background concentrations and compared to screening concentrations (levels at which change has been reported) to provide an assessment regarding the potential for adversely impacting vegetation with significant commercial and/or recreational value.

Screening concentrations used in this assessment represent the minimum ambient concentrations reported in the scientific literature for which adverse effects (e.g., visible damage or growth retardation) to plants have been reported. Of the pollutants emitted by the proposed facility that triggered PSD review, vegetative screening concentrations are available for CO, SO_2, and NO_2. Screening concentrations for particulate matter are not currently available.
Table 5-35 presents a comparison of maximum modeled concentrations from the proposed Keasbey and existing Woodbridge facilities (including ambient background levels) for the three constituent pollutants of concern (i.e., SO_2, NO_2, and CO) with their respective vegetation screening concentrations. This table demonstrates that modeled ground-level concentrations

from the combined facilities are well below levels at which even sensitive vegetation would be affected; thus, the proposed Keasbey facility in combination with the existing Woodbridge facility will not adversely impact vegetation in the site area.

5.11.2 Impact on Visibility

In order to assess the potential impact on regional visibility, the conservative Level–1 screening analysis using the VISCREEN model was conducted. At the Department's request, the scenic vista distance to Liberty State Park in Jersey City, New Jersey (30 km from the proposed facility site) was used. This value is less than the 40 km visual background range indicated on Figure 9 – Regional Background Values, in the visibility assessment procedure described in the "Workbook for Plume Visual Impact Screening and Analysis" (U.S. EPA, 1988). The screening procedure involves calculation of three plume contrast coefficients using emissions of NO_2, PM/PM-10, and sulfates (H_2SO_4). The Level-1 screening procedure determines the light scattering impacts of particulates, including sulfates and nitrates, with a mean diameter of two micrometers with a standard deviation of two micrometers. It was conducted assuming that all emitted particulate would be as PM-10, which results in a conservative assessment of visibility impact. These coefficients consider plume/sky contrast, plume/terrain contrast, and sky/terrain contrast.

A Level-1 screening analysis using the U.S. EPA VISCREEN (version 13190) model was performed for the calculated potential to emit (PTE) emissions for the existing Woodbridge and proposed Keasbey facilities. The visibility assessment was performed for an observer at the closer scenic vista distance of 30 kilometers from the proposed facility site. A neutral or "D" stability and the average wind speed at the Newark Liberty International Airport meteorological tower during the aforementioned five year period from 2010-2014 (4.39 meters per second) were used. The results of the analysis are presented in Table 5-36 which indicate that the combined facility will not impact visibility in the area surrounding the project site.

5.11.3 Impact on Industrial, Commercial, and Residential Growth

The operation of the proposed facility will generate tax revenue for the local, county, and state economies. Additionally, the proposed facility will produce electricity that will be transmitted for delivery to the Pennsylvania-Jersey-Maryland (PJM) Regional Transmission Grid. It is anticipated that 500-600 construction workers will be employed during the 30 month construction phase of the proposed facility. It is also anticipated that up to an additional six (6) full time jobs will be created for the combined facility operations with additional indirect ancillary service jobs being created to support the proposed facility.

Finally, since the air emissions from the proposed facility will not result in excessive PSD increment consumption, increment is available for new industry desiring to locate in the area.

Therefore, the proposed facility should have no effect on future industrial, commercial, or residential growth in the region.

5.12 Modeling Data Files

All modeling data files for the PSD modeling analyses to determine the maximum ambient ground-level concentrations from the proposed facility are included on DVD-ROM in Appendix H. The modeling files DVD contains a README.TXT file describing the files that are provided as well as a glossary of source ID and group name definitions.

5.13 References

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Air Quality Modeling Protocol, February 18, 2021 conditionally approved by NJDEP on April 19, 2021.

Table 5-1: Maximum Measured Ambient Air Quality Concentrations

Pollutant	Averaging Period	Maximum Ambient Concentrations (µg/m³)			NAAQS (µg/m³)	Monitor Location	SIL (ug/m³)	NAAQS – Background (ug/m³)	Is NAAQS – Background Greater than SIL? (Y/N)
		2017	2018	2019					
SO_2	1-Hour[a] 3-Hour 24-Hour Annual	7.9 7.9 2.6 0.3	17.8 **13.9** **5.5** 0.5	10.2 7.9 5.2 **0.8**	197 1,300 365 80	Elizabeth Lab, Union County, NJ, #34-039-0004	7.8 25 5 1	185 1,286 360 79	Y Y Y Y
NO_2	1-Hour[b] Annual	77.1 15.0	79.0 15.0	84.6 **16.9**	188 100	East Brunswick, Middlesex County, NJ, #34-023-0011	7.5 1	108 83	Y Y
CO	1-Hour 8-Hour	2,185 **1,495**	**2,415** 1,380	1,840 **1,495**	40,000 10,000	Elizabeth Lab, Union County, NJ, #34-039-0004	2,000 500	37,585 8,505	Y Y
PM-10	24-Hour	32	**33**	**33**	150	Jersey City, Hudson County, NJ, #34-017-1003	5	117	Y
PM-2.5[c]	24-Hour Annual	18.8 8.3	18.6 8.0	17.1 7.9	35 12	New Brunswick, Middlesex County, NJ, #34-023-0011	1.2 0.3	17 4	Y Y

[a]1-hour 3-year average 99th percentile value for SO_2 is **12.0** ug/m³.
[b]1-hour 3-year average 98th percentile value for NO_2 is **80.2** ug/m³.
[c]24-hour 3-year average 98th percentile value for PM-2.5 is **18.2** ug/m³; Annual 3-year average value for PM-2.5 is **8.1** ug/m³.
High second-high short term (1-, 3-, 8-, and 24-hour) and maximum annual average concentrations presented for all pollutants other than PM-2.5 and 1-hour SO_2 and NO_2.
Bold values represent the proposed background values for use in any necessary NAAQS analyses.
Monitored background concentrations obtained from the NJDEP NJ Air Quality Monitoring Report (2017-2019).

Table 5-2a: Keasbey GEP Analysis

Structure	Facility	Structure Height (ft)	Max Projected Width (ft)	5L Region of Influence Distance (ft)	Calculated GEP Stack Height (ft)	Distance to Keasbey Turbine Stack (ft)
Demin Water Tank	Keasbey	40.0	50.0	200.0	100.0	361.3
Cooling Tower Cell 01	Keasbey	54.0	28.0	140.0	96.0	201.1
Cooling Tower Cell 02	Keasbey	54.0	28.0	140.0	96.0	234.4
Cooling Tower Cell 03	Keasbey	54.0	28.0	140.0	96.0	160.4
Cooling Tower Cell 04	Keasbey	54.0	28.0	140.0	96.0	174.5
Cooling Tower Cell 05	Keasbey	54.0	28.0	140.0	96.0	200.4
Cooling Tower Cell 06	Keasbey	54.0	28.0	140.0	96.0	163.3
Cooling Tower Cell 07	Keasbey	54.0	28.0	140.0	96.0	128.5
Cooling Tower Cell 08	Keasbey	54.0	28.0	140.0	96.0	112.8
Cooling Tower Cell 09	Keasbey	54.0	28.0	140.0	96.0	118.4
Cooling Tower Cell 10	Keasbey	54.0	28.0	140.0	96.0	167.4
Cooling Tower Building	Keasbey	40.0	290.0	200.0	100.0	99.0
Combustion Turbine Bld	Keasbey	31.0	73.0	155.0	77.5	157.0
HRSG Tier 01	Keasbey	64.5	52.0	260.0	142.5	117.0
HRSG Tier 02	Keasbey	94.0	110.0	470.0	235.0	12.0
Steam Turbine Bld	Keasbey	46.0	129.0	230.0	115.0	238.0
Air Inlet Filter	Keasbey	44.0	66.0	220.0	110.0	214.0
Raw Water Tank	Keasbey	60.0	67.0	300.0	150.0	76.6
Combustion Turbine 01 Tier 01	Woodbridge	30.0	60.0	149.9	75.0	593.0
HRSG 01 Tier 01	Woodbridge	49.0	73.0	245.0	122.5	567.0
HRSG 01 Tier 02	Woodbridge	95.0	87.0	435.0	225.5	547.0
Combustion Turbine 01 Tier 02	Woodbridge	30.0	44.0	149.9	75.0	609.0
Air Inlet Filter 01	Woodbridge	81.8	56.0	280.0	165.8	621.0
Combustion Turbine 02 Tier 01	Woodbridge	30.0	60.0	149.9	75.0	718.0
HRSG 02 Tier 01	Woodbridge	49.0	73.0	245.0	122.5	695.0
HRSG 02 Tier 02	Woodbridge	95.0	87.0	435.0	225.5	677.0
Combustion Turbine 02 Tier 02	Woodbridge	30.0	44.0	149.9	75.0	732.0
Air Inlet Filter 02	Woodbridge	81.8	56.0	280.0	165.8	741.0
Steam Turbine Building	Woodbridge	44.0	121.0	220.0	110.0	476.0
Warehouse Building	Woodbridge	25.0	177.0	125.0	62.5	276.0
Demin Water Tank	Woodbridge	24.2	40.0	120.9	60.4	445.8
Cooling Tower Building	Woodbridge	41.9	351.0	209.3	104.7	413.0
Cooling Tower Cell 01	Woodbridge	55.0	30.0	150.0	100.0	710.2
Cooling Tower Cell 02	Woodbridge	55.0	30.0	150.0	100.0	718.3
Cooling Tower Cell 03	Woodbridge	55.0	30.0	150.0	100.0	663.2
Cooling Tower Cell 04	Woodbridge	55.0	30.0	150.0	100.0	671.7
Cooling Tower Cell 05	Woodbridge	55.0	30.0	150.0	100.0	616.3
Cooling Tower Cell 06	Woodbridge	55.0	30.0	150.0	100.0	625.3
Cooling Tower Cell 07	Woodbridge	55.0	30.0	150.0	100.0	569.2
Cooling Tower Cell 08	Woodbridge	55.0	30.0	150.0	100.0	579.2
Cooling Tower Cell 09	Woodbridge	55.0	30.0	150.0	100.0	522.7
Cooling Tower Cell 10	Woodbridge	55.0	30.0	150.0	100.0	533.3
Cooling Tower Cell 11	Woodbridge	55.0	30.0	150.0	100.0	476.0
Cooling Tower Cell 12	Woodbridge	55.0	30.0	150.0	100.0	487.4
Cooling Tower Cell 13	Woodbridge	55.0	30.0	150.0	100.0	429.8
Cooling Tower Cell 14	Woodbridge	55.0	30.0	150.0	100.0	442.4

Table 5-2b: Woodbridge GEP Analysis

Structure	Facility	Structure Height (ft)	Max Projected Width (ft)	5L Region of Influence Distance (ft)	Calculated GEP Stack Height (ft)	Distance to Woodbridge Turbine 01 Stack (ft)	Distance to Woodbridge Turbine 02 Stack (ft)
Demin Water Tank	Keasbey	40.0	50.0	200.0	100.0	382.0	493.5
Cooling Tower Cell 01	Keasbey	54.0	28.0	140.0	96.0	425.7	547.0
Cooling Tower Cell 02	Keasbey	54.0	28.0	140.0	96.0	450.0	566.4
Cooling Tower Cell 03	Keasbey	54.0	28.0	140.0	96.0	475.3	598.3
Cooling Tower Cell 04	Keasbey	54.0	28.0	140.0	96.0	544.9	665.5
Cooling Tower Cell 05	Keasbey	54.0	28.0	140.0	96.0	496.6	615.3
Cooling Tower Cell 06	Keasbey	54.0	28.0	140.0	96.0	594.9	717.0
Cooling Tower Cell 07	Keasbey	54.0	28.0	140.0	96.0	525.8	650.0
Cooling Tower Cell 08	Keasbey	54.0	28.0	140.0	96.0	577.3	702.5
Cooling Tower Cell 09	Keasbey	54.0	28.0	140.0	96.0	628.6	754.6
Cooling Tower Cell 10	Keasbey	54.0	28.0	140.0	96.0	644.7	768.0
Cooling Tower Building	Keasbey	40.0	290.0	200.0	100.0	405.0	527.0
Combustion Turbine Bld	Keasbey	31.0	73.0	155.0	77.5	569.0	698.0
HRSG Tier 01	Keasbey	64.5	52.0	260.0	142.5	559.0	690.0
HRSG Tier 02	Keasbey	94.0	110.0	470.0	235.0	556.0	688.0
Steam Turbine Bld	Keasbey	46.0	129.0	230.0	115.0	583.0	709.0
Air Inlet Filter	Keasbey	44.0	66.0	220.0	110.0	500.0	626.0
Raw Water Tank	Keasbey	60.0	67.0	300.0	150.0	649.6	780.1
Combustion Turbine 01 Tier 01	Woodbridge	30.0	60.0	149.9	75.0	143.0	183.0
HRSG 01 Tier 01	Woodbridge	49.0	73.0	245.0	122.5	79.0	132.0
HRSG 01 Tier 02	Woodbridge	95.0	87.0	435.0	225.5	18.0	99.0
Combustion Turbine 01 Tier 02	Woodbridge	30.0	44.0	149.9	75.0	197.0	226.0
Air Inlet Filter 01	Woodbridge	81.8	56.0	280.0	165.8	226.0	251.0
Combustion Turbine 02 Tier 01	Woodbridge	30.0	60.0	149.9	75.0	183.0	143.0
HRSG 02 Tier 01	Woodbridge	49.0	73.0	245.0	122.5	132.0	79.0
HRSG 02 Tier 02	Woodbridge	95.0	87.0	435.0	225.5	99.0	18.0
Combustion Turbine 02 Tier 02	Woodbridge	30.0	44.0	149.9	75.0	226.0	197.0
Air Inlet Filter 02	Woodbridge	81.8	56.0	280.0	165.8	251.0	226.0
Steam Turbine Building	Woodbridge	44.0	121.0	220.0	110.0	217.0	306.0
Warehouse Building	Woodbridge	25.0	177.0	125.0	62.5	164.0	294.0
Demin Water Tank	Woodbridge	24.2	40.0	120.9	60.4	114.8	240.0
Cooling Tower Building	Woodbridge	41.9	351.0	209.3	104.7	140.0	140.0
Cooling Tower Cell 01	Woodbridge	55.0	30.0	150.0	100.0	203.9	151.9
Cooling Tower Cell 02	Woodbridge	55.0	30.0	150.0	100.0	237.6	193.6
Cooling Tower Cell 03	Woodbridge	55.0	30.0	150.0	100.0	176.8	155.5
Cooling Tower Cell 04	Woodbridge	55.0	30.0	150.0	100.0	214.5	196.7
Cooling Tower Cell 05	Woodbridge	55.0	30.0	150.0	100.0	159.1	172.5
Cooling Tower Cell 06	Woodbridge	55.0	30.0	150.0	100.0	200.0	210.6
Cooling Tower Cell 07	Woodbridge	55.0	30.0	150.0	100.0	153.3	198.5
Cooling Tower Cell 08	Woodbridge	55.0	30.0	150.0	100.0	195.3	232.7
Cooling Tower Cell 09	Woodbridge	55.0	30.0	150.0	100.0	160.8	231.3
Cooling Tower Cell 10	Woodbridge	55.0	30.0	150.0	100.0	201.2	261.3
Cooling Tower Cell 11	Woodbridge	55.0	30.0	150.0	100.0	180.3	268.6
Cooling Tower Cell 12	Woodbridge	55.0	30.0	150.0	100.0	217.6	295.4
Cooling Tower Cell 13	Woodbridge	55.0	30.0	150.0	100.0	208.4	308.5
Cooling Tower Cell 14	Woodbridge	55.0	30.0	150.0	100.0	241.4	331.8

Table 5-2c: Fresh Kills Landfill Receptors

UTM Easting (m), NAD83, Zone 18	UTM Northing (m), NAD83, Zone 18	Elevation (m)	Scale Height (m)
566,929	4,490,761	17.5	17.5
566,929	4,490,511	24.0	24.0
566,929	4,490,261	41.2	41.2
566,929	4,490,011	36.3	36.3
567,179	4,491,011	26.7	26.7
567,179	4,490,761	42.2	42.2
567,179	4,490,511	51.1	51.1
567,179	4,490,261	52.6	52.6
567,179	4,490,011	38.8	38.8
567,429	4,491,011	36.6	36.6
567,429	4,490,761	53.1	53.1
567,429	4,490,511	60.4	60.4
567,429	4,490,261	48.3	48.3
567,429	4,490,011	27.4	27.4
569,929	4,493,011	21.4	21.4
567,679	4,491,011	38.1	38.1
567,679	4,490,761	45.2	45.2
567,679	4,490,511	30.8	30.8
567,679	4,490,261	21.8	21.8
568,679	4,491,511	22.7	22.7
568,679	4,492,261	15.0	15.0
568,679	4,492,511	26.8	26.8
568,679	4,492,761	19.4	19.4
568,929	4,492,261	10.8	10.8
568,929	4,492,511	29.4	29.4
568,929	4,492,761	18.3	18.3
569,429	4,491,011	22.0	22.0
569,929	4,492,011	15.2	15.2
569,929	4,492,511	27.7	27.7
568,810	4,492,555	38.1	38.1
569,800	4,492,620	38.1	38.1
569,740	4,491,690	27.4	27.4
568,680	4,491,530	27.4	27.4
569,300	4,490,985	30.5	30.5
567,325	4,490,535	68.6	68.6

Table 5-3: Keasbey Energy Center Combustion Turbine/HRSG Source Parameters

Operating Case	Fuel	Ambient Temperature (F)	Operating Load (%)	Duct Firing (On/Off)	Evaporative Cooler Operation (On/Off)	Modeling Stack Parameters		
						Exhaust Temperature (K)	Exhaust Velocity (m/s)[a]	Exhaust Flow (acfm)
Case1	Gas	-8	100	On	Off	335.37	22.23	1,663,088
Case2	Gas	-8	100	Off	Off	345.37	22.66	1,695,786
Case3	Gas	-8	75	Off	Off	342.59	17.98	1,345,657
Case4	Gas	-8	46	Off	Off	341.48	14.07	1,053,192
Case5	Gas	59	100	On	Off	337.04	21.93	1,640,987
Case6	Gas	59	100	Off	Off	345.93	22.29	1,667,946
Case7	Gas	59	75	Off	Off	341.48	17.14	1,282,564
Case8	Gas	59	30	Off	Off	337.59	11.05	827,022
Case9	Gas	105	100	On	On	339.26	21.04	1,574,584
Case10	Gas	105	100	Off	On	349.82	21.47	1,606,470
Case11	Gas	105	100	On	Off	337.04	19.20	1,436,816
Case12	Gas	105	100	Off	Off	347.59	19.58	1,464,813
Case13	Gas	105	75	Off	Off	345.93	16.10	1,205,008
Case14	Gas	105	50	Off	Off	344.82	13.26	992,066
Case15	Gas	-8	100	On	Off	343.71	22.58	1,689,282
Case16	Gas	59	100	On	On	337.59	22.31	1,669,789

[a]Based on a stack diameter of 22 feet.
UTM coordinates of proposed 160 foot above grade combustion turbine/HRSG stack are 557,515 meters Easting, 4,485,100 meters Northing, NAD83, Zone 18 at a base elevation of 22.5 feet above mean sea level.

<u>Sample Exhaust Velocity (m/s) Calculation: Case #1</u>
Exhaust Velocity (m/s) = (ft^3/min * min/sec * m^3/ft^3) / Pi * ((diameter^2)/4)
Exhaust Velocity (m/s) = (1,663,088 ft^3/min * 1 min/60 sec * 1 m^3/35.3145 ft^3) / Pi * ((6.7056 m^2)/4)
Exhaust Velocity = 22.23 m/s

Table 5-4: Keasbey Energy Center Combustion Turbine/HRSG Emission Rates

Operating Case	Modeled Emission Rate (g/s)			
	NO_x	CO	PM-10/PM-2.5	SO_2
Case1	4.11	2.51	2.91	1.20
Case2	3.33	2.03	1.76	0.97
Case3	2.65	1.61	1.65	0.77
Case4	1.90	1.16	1.52	0.55
Case5	4.03	2.46	2.86	1.17
Case6	3.28	1.99	1.75	0.96
Case7	2.56	1.55	1.63	0.75
Case8	1.42	0.87	1.44	0.42
Case9	3.87	2.36	2.87	1.13
Case10	3.09	1.88	1.73	0.90
Case11	3.80	2.31	2.98	1.11
Case12	2.82	1.71	1.68	0.82
Case13	2.23	1.36	1.58	0.65
Case14	1.70	1.04	1.49	0.50
Case15	3.41	2.08	2.78	0.99
Case16	4.13	2.52	2.92	1.21

Table 5-5: Keasbey Energy Center Auxiliary Boiler Exhaust Characteristics and Emissions

Emission Parameter	
Pollutant	**lb/hr**
NO_x	0.72
CO	2.68
PM-10/PM-2.5	0.51
SO_2	0.15
Exhaust Parameter	
Exhaust Height (ft above grade)	40
Exhaust Height (m above grade)	12.19
Exhaust Temperature (deg F)	300
Exhaust Flow (acfm)	22,250
Exhaust Velocity (ft/sec)	52.46
Exhaust Velocity (m/sec)	15.99
Inner Diameter (ft)	3
Inner Diameter (m)	0.91
Stack Base Elevation (ft)	22.5
UTM Easting (m), NAD83, Zone 18	557,541
UTM Northing (m), NAD83, Zone 18	4,485,141

<u>Modeled Emission Rates (g/s)</u>

1-hour CO = 0.34 g/s
1-hour SO_2 = 0.02 g/s
24-hour PM-10/PM-2.5 = 0.06 g/s
1-hour NO_2 = 0.09 g/s
3-hour SO_2 = 0.02 g/s
8-hour CO = 0.34 g/s
24-hour SO_2 = 0.02 g/s
Annual NO_2 = 0.09 g/s x (4000 hours/8760 hours) = 0.041 g/s
Annual PM-10/PM-2.5 = 0.06 g/s x (4000 hours/8760 hours) = 0.027 g/s
Annual SO_2 = 0.02 g/s x (4000 hours x 8760 hours) = 0.009 g/s

Table 5-6: Keasbey Energy Center Emergency Diesel Fire Pump Exhaust Characteristics and Emissions

Emission Parameter	
Pollutant	**lb/hr**
NO_x	1.81
CO	0.95
PM-10/PM-2.5	0.08
SO_2	0.003
Exhaust Parameter	
Exhaust Height (ft above grade)	26
Exhaust Height (m above grade)	7.92
Exhaust Temperature (deg F)	1,076
Exhaust Flow (acfm)	1,900
Exhaust Velocity (ft/sec)	90.72
Exhaust Velocity (m/sec)	27.65
Inner Diameter (ft)	0.67
Inner Diameter (m)	0.20
Stack Base Elevation (ft)	22.5
UTM Easting (m), NAD83, Zone 18	557,482
UTM Northing (m), NAD83, Zone 18	4,485,119

<u>Modeled Emission Rates (g/s)</u>

[b]1-hour NO_2 = 0.23 g/s x (100 hours/8760 hours) = 2.63E-3 g/s
1-hour CO = 0.12 g/s
[b]1-hour SO_2 = 0.0004 g/s x (100 hours/8760 hours) = 4.57E-6 g/s
3-hour SO_2 = 0.0004 g/s x (1 hour/3 hours) = 1.33E-4 g/s
8-hour CO = 0.12 g/s x (1 hour/8 hours) = 0.015 g/s
24-hour PM-10/PM-2.5 = 0.01 g/s x (1 hour/24 hours) = 4.17E-4 g/s
24-hour SO_2 = 0.0004 g/s x (1 hour/24 hours) = 1.67E-5 g/s
Annual NO_2 = 0.23 g/s x (100 hours/8760 hours) = 2.63E-3 g/s
Annual PM-10-PM-2.5 = 0.01 g/s x (100 hours/8760 hours) = 1.14E-4 g/s
Annual SO_2 = 0.0004 g/s x (100 hours/8760 hours) = 4.57E-6 g/s

[b]Average hourly emission rate determined by multiplying the maximum hourly emission rate times 100 hours/8760 hours, per the March 1, 2011 guidance memorandum from Tyler Fox (EPA OAQPS) titled "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-Hour NO_2 NAAQS".

Table 5-7: Keasbey Energy Center Emergency Diesel Generator Exhaust Characteristics and Emissions

Emission Parameter	
Pollutant	**lb/hr**
NO_x	17.10
CO	9.64
PM-10/PM-2.5	0.55
SO_2	0.037
Exhaust Parameter	
Exhaust Height (ft above grade)	20
Exhaust Height (m above grade)	6.10
Exhaust Temperature (deg F)	759
Exhaust Flow (acfm)	10,908.7
Exhaust Velocity (ft/sec)	231.49
Exhaust Velocity (m/sec)	70.56
Inner Diameter (ft)	1
Inner Diameter (m)	0.30
Stack Base Elevation (ft)	22.5
UTM Easting (m), NAD83, Zone 18	557,564
UTM Northing (m), NAD83, Zone 18	4,485,151

Modeled Emission Rates (g/s)

[b]1-hour NO_2 = 2.15 g/s x (100 hours/8760 hours) = 0.025 g/s
1-hour CO = 1.21 g/s
[b]1-hour SO_2 = 0.0047 g/s x (100 hours/8760 hours) = 5.37E-5 g/s
3-hour SO_2 = 0.0047 g/s x (1 hour/3 hours) = 1.57E-3 g/s
8-hour CO = 1.21 g/s x (1 hour/8 hours) = 0.15 g/s
24-hour PM-10/PM-2.5 = 0.07 g/s x (1 hour/24 hours) = 2.92E-3 g/s
24-hour SO_2 = 0.0047 g/s x (1 hour/24 hours) = 1.96E-4 g/s
Annual NO_2 = 2.15 g/s x (100 hours/8760 hours) = 0.025 g/s
Annual PM-10/PM-2.5 = 0.07 g/s x (100 hours/8760 hours) = 7.99E-4 g/s
Annual SO_2 = 0.0047 g/s x (100 hours/8760 hours) = 5.37E-5 g/s

[b]Average hourly emission rate determined by multiplying the maximum hourly emission rate times 100 hours/8760 hours, per the March 1, 2011 guidance memorandum from Tyler Fox (EPA OAQPS) titled "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-Hour NO_2 NAAQS".

Table 5-8: Keasbey Energy Center Cooling Tower Exhaust Characteristics and PM-10/PM-2.5 Emission Rates

Emissions Parameter	
Number of Cells (up to)	10
Maximum Total Air Flow Rate (acfm) (Each Cell)	1,448,000
Maximum Water Flow Rate (gpm) (Total Tower)	153,000
Maximum Drift Rate	0.0005%
Total Solids in Circulating Water (ppm)	6,240
10-cell Total TSP Emission Rate (lb/hr) (Total Tower)	2.39
1-cell TSP Emission Rate (g/s)	0.030
10-cell Total PM-10 Emission Rate (lb/hr) (Total Tower)	1.55
1-cell PM-10 Emission Rate (g/s)	0.020
10-cell Total PM-2.5 Emission Rate (lb/hr) (Total Tower)	0.58
1-cell PM-2.5 Emission Rate (g/s)	0.007
10-cell Total TSP Annual Emission Rate (ton/yr) (Total Tower)	10.46
10-cell Total PM-10 Annual Emission Rate (ton/yr) (Total Tower)	6.81
10-cell Total PM-2.5 Annual Emission Rate (ton/yr) (Total Tower)	2.56
Exhaust Parameter	
Exhaust Height (ft above grade)	54
Exhaust Height (m above grade)	16.46
Collar Height (ft above grade)	40
Collar Height (m above grade)	12.19
Exhaust Temperature (deg F)	80
Exhaust Velocity (ft/sec)	40.63
Exhaust Velocity (m/sec)	12.38
Inner Diameter (ft)	27.5
Inner Diameter (m)	8.38
Base elevation (ft)	22.5

Table 5-9: Keasbey Energy Center Cooling Tower Cell Location Coordinates

Cooling Tower Cell #	UTM Easting, Zone 18, NAD83 (m)	UTM Northing, Zone 18, NAD83 (m)
1	557,510	4,485,061
2	557,527	4,485,064
3	557,543	4,485,067
4	557,559	4,485,071
5	557,575	4,485,074
6	557,514	4,485,045
7	557,530	4,485,049
8	557,546	4,485,052
9	557,562	4,485,056
10	557,578	44,85,059

Table 5-10: Woodbridge Energy Center Cooling Tower Exhaust Characteristics and PM-10/PM-2.5 Emission Rates

Emissions Parameter	
Number of Cells	14
Maximum Total Air Flow Rate (acfm) (Each Cell)	1,341,000
Maximum Water Flow Rate (gpm) (Total Tower)	148,000
Maximum Drift Rate	0.0005%
Total Solids in Circulating Water (ppm)	6,240
14-cell Total TSP Emission Rate (lb/hr) (Total Tower)	2.31
1-cell TSP Emission Rate (g/s)	0.021
14-cell Total PM-10 Emission Rate (lb/hr) (Total Tower)	1.5
1-cell PM-10 Emission Rate (g/s)	0.014
14-cell Total PM-2.5 Emission Rate (lb/hr) (Total Tower)	0.56
1-cell PM-2.5 Emission Rate (g/s)	0.005
14-cell Total TSP Annual Emission Rate (ton/yr) (Total Tower)	10.12
14-cell Total PM-10 Annual Emission Rate (ton/yr) (Total Tower)	6.58
14-cell Total PM-2.5 Annual Emission Rate (ton/yr) (Total Tower)	2.43
Exhaust Parameter	
Exhaust Height (ft above grade)	55
Exhaust Height (m above grade)	16.76
Collar Height (ft above grade)	41.85
Collar Height (m above grade)	12.76
Exhaust Temperature (deg F)	85
Exhaust Velocity (ft/sec)	31.62
Exhaust Velocity (m/sec)	9.64
Inner Diameter (ft)	30
Inner Diameter (m)	9.14
Base elevation (ft)	19.5

Table 5-11: Woodbridge Energy Center Cooling Tower Cell Location Coordinates

Cooling Tower Cell #	UTM Easting, Zone 18, NAD83 (m)	UTM Northing, Zone 18, NAD83 (m)
1	557,650	4,485,094
2	557,665	4,485,097
3	557,679	4,485,100
4	557,693	4,485,103
5	557,708	4,485,107
6	557,722	4,485,110
7	557,736	4,485,113
8	557,653	4,485,082
9	557,667	4,485,085
10	557,682	4,485,088
11	557,696	4,485,091
12	557,710	4,485,094
13	557,725	4,485,097
14	557,739	4,485,100

Table 5-12: Woodbridge Energy Center Combustion Turbine/HRSG Source Parameters

Operating Case	Fuel	Ambient Temperature (F)	Operating Load (%)	Duct Firing (On/Off)	Evaporative Cooler Operation (On/Off)	Modeling Stack Parameters		
						Exhaust Temperature (K)	Exhaust Velocity (m/s)[a]	Exhaust Flow (acfm)
Case1	Gas	-8	100	Off	Off	360.2	20.00	1,237,051
Case2	Gas	-8	100	On	Off	353.0	19.74	1,220,716
Case3	Gas	-8	75	Off	Off	353.9	15.93	985,177
Case4	Gas	-8	50	Off	Off	346.5	12.47	771,092
Case5	Gas	56	100	Off	Off	357.6	18.30	1,131,842
Case6	Gas	56	100	On	Off	351.4	18.12	1,120,712
Case7	Gas	59	100	On	Off	351.4	18.03	1,115,284
Case8	Gas	56	75	Off	Off	349.4	14.17	876,317
Case9	Gas	59	50	Off	Off	345.5	11.85	732,549
Case10	Gas	105	100	Off	On	362.4	17.94	1,109,399
Case11	Gas	105	100	On	On	357.6	17.77	1,098,857
Case12	Gas	105	100	On	On	356.0	17.77	1,099,012
Case13	Gas	105	75	Off	Off	352.8	13.50	834,647
Case14	Gas	105	50	Off	Off	351.0	12.19	753,867

[a]Based on a stack diameter of 20 feet.
UTM coordinates of two (2) 145 foot combustion turbine stacks are 557,683 meters Easting, 4,485,153 meters Northing, and 557,722 meters Easting, 4,485,161 meters Northing, NAD83, Zone 18 at a base elevation of 19.5 feet above mean sea level.

Table 5-13: Woodbridge Energy Center Combustion Turbine/HRSG Emission Rates

Operating Case	Modeled Emission Rate (g/s) – per turbine			
	NO_x	CO	PM-10/PM-2.5	SO_2
Case1	2.12	1.29	1.52	0.52
Case2	2.49	1.52	2.12	0.62
Case3	1.68	1.02	1.45	0.42
Case4	1.34	0.82	1.39	0.33
Case5	1.92	1.17	1.49	0.47
Case6	2.29	1.40	2.08	0.55
Case7	2.31	1.41	2.41	0.57
Case8	1.55	0.95	1.42	0.38
Case9	1.22	0.74	1.36	0.30
Case10	1.81	1.11	1.47	0.44
Case11	2.02	1.22	1.76	0.49
Case12	2.23	1.36	2.39	0.54
Case13	1.41	0.86	1.40	0.34
Case14	1.17	0.72	1.35	0.29

Table 5-14: Woodbridge Energy Center Auxiliary Boiler Exhaust Characteristics and Emissions

Emission Parameter	
Pollutant	**lb/hr**
NO_x	0.92
CO	3.44
PM-10/PM-2.5	0.46
SO_2	0.16
Exhaust Parameter	
Exhaust Height (ft above grade)	40
Exhaust Height (m above grade)	12.19
Exhaust Temperature (deg F)	310
Exhaust Velocity (ft/sec)	57.3
Exhaust Velocity (m/sec)	17.5
Inner Diameter (ft)	3.3
Inner Diameter (m)	0.99
Stack Base Elevation (ft)	19.5
UTM Easting (m), NAD83, Zone 18	557,636
UTM Northing (m), NAD83, Zone 18	4,485,176

Modeled Emission Rates (g/s)

1-hour CO = 0.43 g/s
1-hour SO_2 = 0.02 g/s
24-hour PM-10/PM-2.5 = 0.06 g/s
1-hour NO_2 = 0.12 g/s
3-hour SO_2 = 0.02 g/s
8-hour CO = 0.43 g/s
24-hour SO_2 = 0.02 g/s
Annual NO_2 = 0.12 g/s x (2000 hours/8760 hours) = 0.027 g/s
Annual SO_2 = 0.02 g/s x (2000 hours/8760 hours) = 0.005 g/s
Annual PM-10/PM-2.5 = 0.06 g/s x (2000 hours/8760 hours) = 0.014 g/s

Table 5-15: Woodbridge Energy Center Emergency Diesel Fire Pump Exhaust Characteristics and Emissions

Emission Parameter	
Pollutant	**lb/hr**
NO_x	1.93
CO	1.81
PM-10/PM-2.5	0.10
SO_2	0.003
Exhaust Parameter	
Exhaust Height (ft above grade)	20
Exhaust Height (m above grade)	6.10
Exhaust Temperature (deg F)	961
Exhaust Velocity (ft/sec)	171.1
Exhaust Velocity (m/sec)	52.2
Inner Diameter (ft)	0.4
Inner Diameter (m)	0.13
Stack Base Elevation (ft)	19.5
UTM Easting (m), NAD83, Zone 18	557,604
UTM Northing (m), NAD83, Zone 18	4,485,216

Modeled Emission Rates (g/s)

[b]1-hour NO_2 = 0.24 g/s x (100 hours/8760 hours) = 2.74E-3 g/s
1-hour CO = 0.23 g/s
[b]1-hour SO_2 = 0.0004 g/s x (100 hours/8760 hours) = 4.57E-6 g/s
3-hour SO_2 = 0.0004 g/s x (1 hour/3 hours) = 1.33E-4 g/s
8-hour CO = 0.23 g/s x (1 hour/8 hours) = 0.029 g/s
24-hour PM-10/PM-2.5 = 0.01 g/s x (1 hour/24 hours) = 4.17E-4 g/s
24-hour SO_2 = 0.0004 g/s x (1 hour/24 hours) = 1.67E-5 g/s
Annual NO_2 = 0.24 g/s x (100 hours/8760 hours) = 2.74E-3 g/s
Annual PM-10/PM-2.5 = 0.01 g/s x (100 hours/8760 hours) = 1.14E-4 g/s
Annual SO_2 = 0.0004 g/s x (100 hours/8760 hours) = 4.57E-6 g/s

[b]Average hourly emission rate determined by multiplying the maximum hourly emission rate times 100 hours/8760 hours, per the March 1, 2011 guidance memorandum from Tyler Fox (EPA OAQPS) titled "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-Hour NO_2 NAAQS".

Table 5-16: Woodbridge Energy Center Emergency Diesel Generator Exhaust Characteristics and Emissions

Emission Parameter	
Pollutant	**lb/hr**
NO_x	21.16
CO	1.99
PM-10/PM-2.5	0.13
SO_2	0.0208
Exhaust Parameter	
Exhaust Height (ft above grade)	30
Exhaust Height (m above grade)	9.14
Exhaust Temperature (deg F)	763.5
Exhaust Velocity (ft/sec)	528.1
Exhaust Velocity (m/sec)	161.0
Inner Diameter (ft)	0.7
Inner Diameter (m)	0.20
Stack Base Elevation (ft)	19.5
UTM Easting (m), NAD83, Zone 18	557,679
UTM Northing (m), NAD83, Zone 18	4,485,227

Modeled Emission Rates (g/s)

[b]1-hour NO_2 = 2.67 g/s x (100 hours/8760 hours) = 0.03 g/s
1-hour CO = 0.25 g/s
[b]1-hour SO_2 = 0.003 g/s x (100 hours/8760 hours) = 3.42E-5 g/s
3-hour SO_2 = 0.003 g/s x (1 hour/3 hours) = 0.001 g/s
8-hour CO = 0.25 g/s x (1 hour/8 hours) = 0.03 g/s
24-hour PM-10/PM-2.5 = 0.02 g/s x (1 hour/24 hours) = 8.33E-4 g/s
24-hour SO_2 = 0.003 g/s x (1 hour/24 hours) = 1.25E-4 g/s
Annual NO_2 = 2.67 g/s x (100 hours/8760 hours) = 0.03 g/s
Annual PM-10-PM-2.5 = 0.02 g/s x (100 hours/8760 hours) = 2.28E-4 g/s
Annual SO_2 = 0.003 g/s x (100 hours/8760 hours) = 3.42E-5 g/s

[b]Average hourly emission rate determined by multiplying the maximum hourly emission rate times 100 hours/8760 hours, per the March 1, 2011 guidance memorandum from Tyler Fox (EPA OAQPS) titled "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-Hour NO_2 NAAQS".

Table 5-16a: Season and Hour of Day Background NO_2 Concentrations Used in AERMOD

Hour	Winter	Spring	Summer	Fall
1	71.4	49.4	29.5	46.4
2	69.0	43.8	26.9	45.7
3	65.2	46.4	30.1	47.0
4	64.5	55.8	28.8	43.8
5	64.5	59.6	28.8	42.7
6	66.4	58.3	32.5	48.3
7	65.8	61.5	36.5	52.6
8	65.2	62.6	42.7	50.8
9	68.2	55.8	37.6	59.6
10	65.8	51.3	32.5	54.5
11	65.8	43.2	27.6	47.0
12	61.5	37.0	26.9	41.4
13	57.0	41.4	22.0	38.9
14	57.0	34.4	19.4	32.0
15	60.2	43.2	20.1	33.3
16	62.0	42.7	17.5	34.4
17	67.7	38.9	19.4	45.1
18	67.7	38.2	16.9	54.0
19	69.6	44.6	18.8	54.0
20	72.0	42.7	20.7	54.0
21	71.4	44.6	22.0	51.3
22	71.4	52.6	23.9	50.8
23	70.9	51.3	24.4	48.3
24	68.2	48.3	24.8	47.0

Note: Concentrations are in ug/m^3.

Table 5-17: Keasbey Energy Center Summary of Load Analysis Modeling Results

Table 5-17
Keasbey Combustion Turbine Load Analysis

Keasbey Energy Center - One (1) GE 7HA.02 Combined Cycle Combustion Turbine - One (1) Stack (160 feet above grade)

1-Hour	MAX XOQ	yymmddhh	UTMX (m)	UTMY (m)	ELEV (m)	NOx (ug/m^3)	CO (ug/m^3)	PM10 (ug/m^3)	PM2.5 (ug/m^3)	SO2 (ug/m^3)	Distance	Direction
CASE01	1.09504	13052907	557,817	4,482,198	8.2	4.50	2.75	NA	NA	1.31	2918	174
CASE02	0.95774	16030909	556,917	4,486,098	22.2	3.19	1.94	NA	NA	0.93	1163	329
CASE03	1.16552	13052907	557,817	4,482,298	4.9	3.09	1.88	NA	NA	0.90	2818	174
CASE04	1.47884	13013103	557,517	4,485,798	7.8	2.81	1.72	NA	NA	0.81	698	0
CASE05	1.08094	13052907	557,817	4,482,198	8.2	4.36	2.66	NA	NA	1.26	2918	174
CASE06	0.96293	16030909	556,917	4,486,098	22.2	3.16	1.92	NA	NA	0.92	1163	329
CASE07	1.22045	13052907	557,817	4,482,298	4.9	3.12	1.89	NA	NA	0.92	2818	174
CASE08	1.94212	13052907	557,717	4,483,398	0.0	2.76	1.69	NA	NA	0.82	1714	173
CASE09	1.0825	13052907	557,817	4,482,198	8.2	4.19	2.55	NA	NA	1.22	2918	174
CASE10	0.95516	16030909	556,917	4,486,098	22.2	2.95	1.80	NA	NA	0.86	1163	329
CASE11	1.19008	13052907	557,817	4,482,298	4.9	4.52	2.75	NA	NA	1.32	2818	174
CASE12	1.03422	13052907	557,817	4,482,198	8.2	2.92	1.77	NA	NA	0.85	2918	174
CASE13	1.23554	13013103	557,517	4,485,898	9.2	2.76	1.68	NA	NA	0.80	798	0
CASE14	1.52395	13013103	557,517	4,485,798	7.8	2.59	1.58	NA	NA	0.76	698	0
CASE15	0.97332	16030909	556,917	4,486,098	22.2	3.32	2.02	NA	NA	0.96	1163	329
CASE16	1.05907	13052907	557,817	4,482,198	8.2	4.37	2.67	NA	NA	1.28	2918	174
3-Hour	**MAX XOQ**	**yymmddhh**	**UTMX (m)**	**UTMY (m)**	**ELEV (m)**	**NOx (ug/m^3)**	**CO (ug/m^3)**	**PM10 (ug/m^3)**	**PM2.5 (ug/m^3)**	**SO2 (ug/m^3)**	**Distance**	**Direction**
CASE01	0.82452	14070712	558,017	4,485,598	5.3	NA	NA	NA	NA	0.99	707	45
CASE02	0.74269	14070712	558,017	4,485,598	5.3	NA	NA	NA	NA	0.72	707	45
CASE03	0.90474	14070712	557,917	4,485,498	4.9	NA	NA	NA	NA	0.70	566	45
CASE04	1.09143	14083112	557,917	4,485,498	4.9	NA	NA	NA	NA	0.60	566	45
CASE05	0.81995	14070712	558,017	4,485,598	5.3	NA	NA	NA	NA	0.96	707	45
CASE06	0.74908	14070712	558,017	4,485,598	5.3	NA	NA	NA	NA	0.72	707	45
CASE07	0.94522	14070712	557,917	4,485,498	4.9	NA	NA	NA	NA	0.71	566	45
CASE08	1.39994	14070712	557,917	4,485,498	4.9	NA	NA	NA	NA	0.59	566	45
CASE09	0.83442	13030621	557,117	4,484,098	1.9	NA	NA	NA	NA	0.94	1078	202
CASE10	0.75271	13030621	557,117	4,484,098	1.9	NA	NA	NA	NA	0.68	1078	202
CASE11	0.95493	13030621	557,217	4,484,298	2.5	NA	NA	NA	NA	1.06	856	200
CASE12	0.84608	13030621	557,117	4,484,098	1.9	NA	NA	NA	NA	0.69	1078	202
CASE13	0.95312	14070712	557,917	4,485,498	4.9	NA	NA	NA	NA	0.62	566	45
CASE14	1.10739	14070712	557,917	4,485,498	4.9	NA	NA	NA	NA	0.55	566	45
CASE15	0.7555	14070712	558,017	4,485,598	5.3	NA	NA	NA	NA	0.75	707	45
CASE16	0.8052	14070712	558,017	4,485,598	5.3	NA	NA	NA	NA	0.97	707	45

Table 5-17
Keasbey Combustion Turbine Load Analysis

8-Hour	MAX XOQ	yymmddhh	UTMX (m)	UTMY (m)	ELEV (m)	NOx (ug/m^3)	CO (ug/m^3)	PM10 (ug/m^3)	PM2.5 (ug/m^3)	SO2 (ug/m^3)	Distance	Direction
CASE01	0.74119	16072216	558,117	4,485,498	4.7	NA	1.86	NA	NA	NA	722	57
CASE02	0.66548	16072216	558,117	4,485,498	4.7	NA	1.35	NA	NA	NA	722	57
CASE03	0.8077	16072216	558,117	4,485,498	4.7	NA	1.30	NA	NA	NA	722	57
CASE04	0.97477	16072216	558,017	4,485,398	4.3	NA	1.13	NA	NA	NA	584	59
CASE05	0.73668	16072216	558,117	4,485,498	4.7	NA	1.81	NA	NA	NA	722	57
CASE06	0.67093	16072216	558,117	4,485,498	4.7	NA	1.34	NA	NA	NA	722	57
CASE07	0.84211	16072216	558,117	4,485,498	4.7	NA	1.31	NA	NA	NA	722	57
CASE08	1.29176	16072216	558,017	4,485,398	4.3	NA	1.12	NA	NA	NA	584	59
CASE09	0.74418	16072216	558,117	4,485,498	4.7	NA	1.76	NA	NA	NA	722	57
CASE10	0.6689	16072216	558,117	4,485,498	4.7	NA	1.26	NA	NA	NA	722	57
CASE11	0.81223	16072216	558,117	4,485,498	4.7	NA	1.88	NA	NA	NA	722	57
CASE12	0.72941	16072216	558,117	4,485,498	4.7	NA	1.25	NA	NA	NA	722	57
CASE13	0.84454	16072216	558,117	4,485,498	4.7	NA	1.15	NA	NA	NA	722	57
CASE14	1.00546	16072216	558,017	4,485,398	4.3	NA	1.05	NA	NA	NA	584	59
CASE15	0.67702	16072216	558,117	4,485,498	4.7	NA	1.41	NA	NA	NA	722	57
CASE16	0.7231	16072216	558,117	4,485,498	4.7	NA	1.82	NA	NA	NA	722	57
24-Hour	**MAX XOQ**	**yymmddhh**	**UTMX (m)**	**UTMY (m)**	**ELEV (m)**	**NOx (ug/m^3)**	**CO (ug/m^3)**	**PM10 (ug/m^3)**	**PM2.5 (ug/m^3)**	**SO2 (ug/m^3)**	**Distance**	**Direction**
CASE01	0.35009	13060224	558,017	4,485,698	6.8	NA	NA	1.02	1.02	0.42	781	40
CASE02	0.30974	13060224	558,017	4,485,698	6.8	NA	NA	0.55	0.55	0.30	781	40
CASE03	0.38553	13060224	558,017	4,485,698	6.8	NA	NA	0.64	0.64	0.30	781	40
CASE04	0.47684	14070724	558,017	4,485,598	5.3	NA	NA	0.72	0.72	0.26	707	45
CASE05	0.34759	13060224	558,017	4,485,698	6.8	NA	NA	0.99	0.99	0.41	781	40
CASE06	0.31258	13060224	558,017	4,485,698	6.8	NA	NA	0.55	0.55	0.30	781	40
CASE07	0.40479	13060224	558,017	4,485,698	6.8	NA	NA	0.66	0.66	0.30	781	40
CASE08	0.65442	14031324	558,117	4,484,698	1.5	NA	NA	0.94	0.94	0.27	724	124
CASE09	0.35151	13060224	558,017	4,485,698	6.8	NA	NA	1.01	1.01	0.40	781	40
CASE10	0.3115	13060224	558,017	4,485,698	6.8	NA	NA	0.54	0.54	0.28	781	40
CASE11	0.38797	13060224	558,017	4,485,698	6.8	NA	NA	1.16	1.16	0.43	781	40
CASE12	0.34351	13060224	558,017	4,485,698	6.8	NA	NA	0.58	0.58	0.28	781	40
CASE13	0.40756	13060224	558,017	4,485,698	6.8	NA	NA	0.64	0.64	0.26	781	40
CASE14	0.49119	14031324	558,117	4,484,698	1.5	NA	NA	0.73	0.73	0.25	724	124
CASE15	0.31582	13060224	558,017	4,485,698	6.8	NA	NA	0.88	0.88	0.31	781	40
CASE16	0.34034	13060224	558,017	4,485,698	6.8	NA	NA	0.99	0.99	0.41	781	40
Annual	**MAX XOQ**	**yymmddhh**	**UTMX (m)**	**UTMY (m)**	**ELEV (m)**	**NOx (ug/m^3)**	**CO (ug/m^3)**	**PM10 (ug/m^3)**	**PM2.5 (ug/m^3)**	**SO2 (ug/m^3)**	**Distance**	**Direction**
CASE01	0.02618	2013	558,117	4,485,498	4.7	0.1076	NA	0.0762	0.0762	0.0314	722	57
CASE02	0.02252	2013	558,117	4,485,498	4.7	0.0750	NA	0.0396	0.0396	0.0218	722	57
CASE03	0.02932	2013	558,117	4,485,498	4.7	0.0777	NA	0.0484	0.0484	0.0226	722	57
CASE04	0.03727	2013	558,117	4,485,498	4.7	0.0708	NA	0.0567	0.0567	0.0205	722	57
CASE05	0.02593	2013	558,117	4,485,498	4.7	0.1045	NA	0.0742	0.0742	0.0303	722	57
CASE06	0.02276	2013	558,117	4,485,498	4.7	0.0747	NA	0.0398	0.0398	0.0218	722	57
CASE07	0.03108	2013	558,117	4,485,498	4.7	0.0796	NA	0.0507	0.0507	0.0233	722	57
CASE08	0.04929	2013	558,017	4,485,398	4.3	0.0700	NA	0.0710	0.0710	0.0207	584	59
CASE09	0.02624	2013	558,117	4,485,498	4.7	0.1015	NA	0.0753	0.0753	0.0297	722	57
CASE10	0.02262	2013	558,117	4,485,498	4.7	0.0699	NA	0.0391	0.0391	0.0204	722	57
CASE11	0.02958	2013	558,117	4,485,498	4.7	0.1124	NA	0.0881	0.0881	0.0328	722	57
CASE12	0.02545	2013	558,117	4,485,498	4.7	0.0718	NA	0.0428	0.0428	0.0209	722	57
CASE13	0.03128	2013	558,117	4,485,498	4.7	0.0698	NA	0.0494	0.0494	0.0203	722	57
CASE14	0.03784	2013	558,117	4,485,498	4.7	0.0643	NA	0.0564	0.0564	0.01892	722	57
CASE15	0.02307	2013	558,117	4,485,498	4.7	0.0787	NA	0.0641	0.0641	0.02284	722	57
CASE16	0.02528	2013	558,117	4,485,498	4.7	0.1044	NA	0.0738	0.0738	0.03059	722	57

Table 5-18: Woodbridge Energy Center Summary of Load Analysis Modeling Results

Table 5-18
Woodbridge Combustion Turbine Load Analysis

Woodbridge Energy Center - Two (2) GE 7FA.05 Combined Cycle Combustion Turbines - Two (2) Stacks (145 feet above grade)

1-Hour	MAX XOQ	yymmddhh	UTMX (m)	UTMY (m)	ELEV (m)	NOx (ug/m^3)	CO (ug/m^3)	PM10 (ug/m^3)	PM2.5 (ug/m^3)	SO2 (ug/m^3)	Distance	Direction
CASE01	4.81214	17021317	557,917	4,484,898	2.3	10.20	6.21	NA	NA	2.50	346	137
CASE02	5.01736	16111119	557,917	4,484,898	2.3	12.49	7.63	NA	NA	3.11	346	137
CASE03	6.83661	16111119	557,917	4,484,898	2.3	11.49	6.97	NA	NA	2.87	346	137
CASE04	9.1413	15051222	557,917	4,484,898	2.3	12.25	7.50	NA	NA	3.02	346	137
CASE05	5.59785	16111119	557,917	4,484,898	2.3	10.75	6.55	NA	NA	2.63	346	137
CASE06	5.78755	16111119	557,917	4,484,898	2.3	13.25	8.10	NA	NA	3.18	346	137
CASE07	5.81324	16111119	557,917	4,484,898	2.3	13.43	8.20	NA	NA	3.31	346	137
CASE08	7.88731	16111119	557,917	4,484,898	2.3	12.23	7.49	NA	NA	3.00	346	137
CASE09	9.57411	15051222	557,917	4,484,898	2.3	11.68	7.08	NA	NA	2.87	346	137
CASE10	5.6046	17021317	557,917	4,484,898	2.3	10.14	6.22	NA	NA	2.47	346	137
CASE11	5.80707	16111119	557,917	4,484,898	2.3	11.73	7.08	NA	NA	2.85	346	137
CASE12	5.84293	16111119	557,917	4,484,898	2.3	13.03	7.95	NA	NA	3.16	346	137
CASE13	8.16088	15051222	557,917	4,484,898	2.3	11.51	7.02	NA	NA	2.77	346	137
CASE14	9.17233	15051222	557,917	4,484,898	2.3	10.73	6.60	NA	NA	2.66	346	137
3-Hour	**MAX XOQ**	**yymmddhh**	**UTMX (m)**	**UTMY (m)**	**ELEV (m)**	**NOx (ug/m^3)**	**CO (ug/m^3)**	**PM10 (ug/m^3)**	**PM2.5 (ug/m^3)**	**SO2 (ug/m^3)**	**Distance**	**Direction**
CASE01	3.80875	13030621	557,622	4,484,949	3.0	NA	NA	NA	NA	1.98	213	197
CASE02	3.98136	13030621	557,622	4,484,949	3.0	NA	NA	NA	NA	2.47	213	197
CASE03	5.86528	13030621	557,622	4,484,949	3.0	NA	NA	NA	NA	2.46	213	197
CASE04	8.00655	15031521	557,917	4,484,898	2.3	NA	NA	NA	NA	2.64	346	137
CASE05	4.61229	13030621	557,622	4,484,949	3.0	NA	NA	NA	NA	2.17	213	197
CASE06	4.73708	13030621	557,622	4,484,949	3.0	NA	NA	NA	NA	2.61	213	197
CASE07	4.7913	13030621	557,622	4,484,949	3.0	NA	NA	NA	NA	2.73	213	197
CASE08	6.93155	13030621	557,622	4,484,949	3.0	NA	NA	NA	NA	2.63	213	197
CASE09	8.51666	15031521	557,917	4,484,898	2.3	NA	NA	NA	NA	2.55	346	137
CASE10	4.74442	13030621	557,622	4,484,949	3.0	NA	NA	NA	NA	2.09	213	197
CASE11	4.84432	13030621	557,622	4,484,949	3.0	NA	NA	NA	NA	2.37	213	197
CASE12	4.86537	13030621	557,622	4,484,949	3.0	NA	NA	NA	NA	2.63	213	197
CASE13	7.16771	13030621	557,622	4,484,949	3.0	NA	NA	NA	NA	2.44	213	197
CASE14	8.10024	13030621	557,622	4,484,949	3.0	NA	NA	NA	NA	2.35	213	197

Table 5-18
Woodbridge Combustion Turbine Load Analysis

8-Hour	MAX XOQ	yymmddhh	UTMX (m)	UTMY (m)	ELEV (m)	NOx (ug/m^3)	CO (ug/m^3)	PM10 (ug/m^3)	PM2.5 (ug/m^3)	SO2 (ug/m^3)	Distance	Direction
CASE01	3.0427	13030624	557,622	4,484,949	3.0	NA	3.93	NA	NA	NA	213	197
CASE02	3.19746	13030624	557,622	4,484,949	3.0	NA	4.86	NA	NA	NA	213	197
CASE03	4.93965	13030624	557,622	4,484,949	3.0	NA	5.04	NA	NA	NA	213	197
CASE04	7.08414	13030624	557,622	4,484,949	3.0	NA	5.81	NA	NA	NA	213	197
CASE05	3.7363	13030624	557,622	4,484,949	3.0	NA	4.37	NA	NA	NA	213	197
CASE06	3.87164	13030624	557,622	4,484,949	3.0	NA	5.42	NA	NA	NA	213	197
CASE07	3.93467	13030624	557,622	4,484,949	3.0	NA	5.55	NA	NA	NA	213	197
CASE08	6.02871	13030624	557,622	4,484,949	3.0	NA	5.73	NA	NA	NA	213	197
CASE09	7.53041	13030624	557,622	4,484,949	3.0	NA	5.57	NA	NA	NA	213	197
CASE10	3.84415	13030624	557,622	4,484,949	3.0	NA	4.27	NA	NA	NA	213	197
CASE11	3.94762	13030624	557,622	4,484,949	3.0	NA	4.82	NA	NA	NA	213	197
CASE12	3.96915	13030624	557,622	4,484,949	3.0	NA	5.40	NA	NA	NA	213	197
CASE13	6.31143	13030624	557,622	4,484,949	3.0	NA	5.43	NA	NA	NA	213	197
CASE14	7.21953	13030624	557,622	4,484,949	3.0	NA	5.20	NA	NA	NA	213	197
24-Hour	**MAX XOQ**	**yymmddhh**	**UTMX (m)**	**UTMY (m)**	**ELEV (m)**	**NOx (ug/m^3)**	**CO (ug/m^3)**	**PM10 (ug/m^3)**	**PM2.5 (ug/m^3)**	**SO2 (ug/m^3)**	**Distance**	**Direction**
CASE01	2.07463	15021524	558,017	4,484,898	2.3	NA	NA	3.15	3.15	1.08	420	127
CASE02	2.22303	15021524	558,017	4,484,898	2.3	NA	NA	4.71	4.71	1.38	420	127
CASE03	3.53098	15021524	557,917	4,484,998	2.8	NA	NA	5.12	5.12	1.48	281	124
CASE04	5.70258	15021524	557,917	4,484,998	2.8	NA	NA	7.93	7.93	1.88	281	124
CASE05	2.51937	15021524	558,017	4,484,898	2.3	NA	NA	3.75	3.75	1.18	420	127
CASE06	2.6577	15021524	558,017	4,484,898	2.3	NA	NA	5.53	5.53	1.46	420	127
CASE07	2.68452	15021524	558,017	4,484,898	2.3	NA	NA	6.47	6.47	1.53	420	127
CASE08	4.58549	15021524	557,917	4,484,998	2.8	NA	NA	6.51	6.51	1.74	281	124
CASE09	6.12208	15021524	557,917	4,484,998	2.8	NA	NA	8.33	8.33	1.84	281	124
CASE10	2.55789	15021524	557,917	4,484,998	2.8	NA	NA	3.76	3.76	1.13	281	124
CASE11	2.6771	15021524	557,917	4,484,998	2.8	NA	NA	4.71	4.71	1.31	281	124
CASE12	2.69625	15021524	557,917	4,484,998	2.8	NA	NA	6.44	6.44	1.46	281	124
CASE13	4.91979	15021524	557,917	4,484,998	2.8	NA	NA	6.89	6.89	1.67	281	124
CASE14	5.79104	15021524	557,917	4,484,998	2.8	NA	NA	7.82	7.82	1.68	281	124
Annual	**MAX XOQ**	**yymmddhh**	**UTMX (m)**	**UTMY (m)**	**ELEV (m)**	**NOx (ug/m^3)**	**CO (ug/m^3)**	**PM10 (ug/m^3)**	**PM2.5 (ug/m^3)**	**SO2 (ug/m^3)**	**Distance**	**Direction**
CASE01	0.07687	2013	558,117	4,484,798	1.8	0.1630	NA	0.1168	0.1168	0.0400	561	129
CASE02	0.08457	2013	558,117	4,484,798	1.8	0.2106	NA	0.1793	0.1793	0.0524	561	129
CASE03	0.12458	2015	558,017	4,484,898	2.3	0.2093	NA	0.1806	0.1806	0.0523	420	127
CASE04	0.21086	2013	558,017	4,484,898	2.3	0.2826	NA	0.2931	0.2931	0.0696	420	127
CASE05	0.09148	2013	558,117	4,484,798	1.8	0.1756	NA	0.1363	0.1363	0.0430	561	129
CASE06	0.09971	2013	558,117	4,484,798	1.8	0.2283	NA	0.2074	0.2074	0.0548	561	129
CASE07	0.10055	2015	558,017	4,484,898	2.3	0.2323	NA	0.2423	0.2423	0.0573	420	127
CASE08	0.16188	2013	558,017	4,484,898	2.3	0.2509	NA	0.2299	0.2299	0.0615	420	127
CASE09	0.23253	2013	558,017	4,484,898	2.3	0.2837	NA	0.3162	0.3162	0.0698	420	127
CASE10	0.0907	2015	558,017	4,484,898	2.3	0.1642	NA	0.1333	0.1333	0.0399	420	127
CASE11	0.09706	2015	558,017	4,484,898	2.3	0.1961	NA	0.1708	0.1708	0.0476	420	127
CASE12	0.09858	2015	558,017	4,484,898	2.3	0.2198	NA	0.2356	0.2356	0.0532	420	127
CASE13	0.16998	2013	558,017	4,484,898	2.3	0.2397	NA	0.2380	0.2380	0.0578	420	127
CASE14	0.20753	2013	558,017	4,484,898	2.3	0.2428	NA	0.2802	0.2802	0.06018	420	127

Table 5-19: Keasbey Energy Center Combustion Turbine Start-up and Shutdown Emission Rates and Stack Parameters

Combustion Turbine Startup/Shutdown Parameters – Rapid Response (Natural Gas Fired)									
Event	**Elapsed Time (hr)**	**Stack NO_x (Max lb/hr)**	**Stack CO (Max lb/hr)**	**Stack SO_2 (Max lb/hr)**	**Stack PM-10 (Max lb/hr)**	**Stack PM-2.5 (Max lb/hr)[a]**	**Stack Exhaust Flow (acfm)**	**Stack Exhaust Velocity (m/s)**	**Stack Exhaust Temperature (Degrees F)**
Startup	1	250.7	225.3	3.00	10.4	10.4	671,086	8.97	160
Shutdown	0.50	17.5	312.5	0.73	5.3	5.3	671,086	8.97	160

	Type of Startup or Shutdown Event	
	Startup	Shutdown
Duration of Turbine at 0% load prior to Start-up (hours)	8	-
Maximum Duration of Start-up or Shut-down Event (hours)	1	0.5
Maximum Number per Year	262	262

Table 5-20: Keasbey Energy Center Combustion Turbine Start-up and Shutdown Modeling Methodology

Transient Condition	Normal Operation Worst Case	Duration	Averaging Period	NO_x		CO		SO_2		PM-10		PM-2.5	
		Hours		lb/hr	g/s	lb//hr	g/s	lb/hr	g/s	lb/hr	g/s	lb/hr	g/s
NG Startup	-	1	1-hour	251	31.6	225	28.4	3.0	0.38	-	-	-	-
NG Shutdown	-	0.5	1-hour	17.5	2.21	313	39.4	0.73	0.09	-	-	-	-
	Case11sd	0.5	1-hour	15.1	1.90	9.2	1.16	4.44	0.56	-	-	-	-
NG Startup	-	1	8-hour	-	-	28.2	3.55	-	-	-	-	-	-
	Case11c	7	8-hour	-	-	16	2.02	-	-	-	-	-	-
NG Shutdown	-	0.5	8-hour	-	-	39.1	4.92	-	-	-	-	-	-
	Case11sd	7.5	8-hour	-	-	17.2	2.17	-	-	-	-	-	-
NG Startup	-	1	3-hour	-	-	-	-	1.0	0.13	-	-	-	-
	Case11c	2	3-hour	-	-	-	-	5.87	0.74	-	-	-	-
NG Shutdown	-	0.5	3-hour	-	-	-	-	0.24	0.03	-	-	-	-
	Case11sd	2.5	3-hour	-	-	-	-	7.34	0.93	-	-	-	-
NG Startup	-	1	24-hour	-	-	-	-	0.13	0.02	0.43	0.06	0.43	0.06
	Case11c	23	24-hour	-	-	-	-	8.44	1.06	22.7	2.86	22.7	2.86
NG Shutdown	-	0.5	24-hour	-	-	-	-	0.03	0.004	0.22	0.03	0.22	0.03
	Case11sd	23.5	24-hour	-	-	-	-	8.6	1.09	23.2	2.92	23.2	2.92

Table 5-21: Woodbridge Energy Center Combustion Turbine Start-up and Shutdown Emission Rates and Stack Parameters (Natural Gas Fired)

GE 7FA.05 Combustion Turbine Start-up/Shutdown Parameters							
Event	**Elapsed Time (hr)**	**Stack NOx (lb/hr)**	**Stack CO (lb/hr)**	**Stack SO_2 (lb/hr)**	**Average Stack Exhaust Flow (acfm)**	**Average Stack Exhaust Velocity (m/s)**	**Average Stack Exhaust Temperature (Degrees F)**
Startup – Per Turbine	3.4	112	941	2.6	550,000	8.89	160
Shutdown – Per Turbine	0.5	68.5	618.4	2.6	550,000	8.89	160

Table 5-22: Woodbridge Energy Center Combustion Turbine Start-up and Shutdown Modeling Methodology

Transient Condition	Normal operation worst case	Duration	Averaging Period	NO_x		CO		SO_2	
		Hours		lb/hr	g/s	lb/hr	g/s	lb/hr	g/s
NG Startup	-	3.4	1-hour	112	14.1	941	119	2.6	0.33
NG Shutdown	-	0.5	1-hour	68.5	8.63	618	77.9	2.6	0.33
	Case7sd	0.5	1-hour	9.2	1.16	5.6	0.71	2.3	0.29
NG Startup	-	3.4	8-hour	-	-	399.93	50.39	-	-
	Case4su	4.6	8-hour	-	-	3.73	0.47	-	-
NG Shutdown	-	0.5	8-hour	-	-	38.65	4.87	-	-
	Case4sd	7.5	8-hour	-	-	6.1	0.77	-	-
NG Startup	-	3.4	3-hour	-	-	-	-	2.6	0.33
NG Shutdown	-	0.5	3-hour	-	-	-	-	0.87	0.11
	Case7sd	2.5	3-hour	-	-	-	-	3.77	0.48
NG Startup	-	3.4	24-hour	-	-	-	-	0.37	0.05
	Case4su	20.6	24-hour	-	-	-	-	2.25	0.28
NG Shutdown	-	0.5	24-hour	-	-	-	-	0.05	0.007
	Case4sd	23.5	24-hour	-	-	-	-	2.56	0.32

Table 5-23: Keasbey and Woodbridge Energy Centers – Annual Emission Rates

	KEC Emissions[a]		WEC Emissions[b]	
Air Contaminant	**TPY**	**g/s**	**TPY**	**g/s**
SO_2	40.2	1.16	11.3	0.165
NO_2	140.8	4.05	145.9	2.1
PM-10	96.3	2.77	92.0	1.32
PM-2.5	96.3	2.77	92.0	1.32

[a] Emissions for the single combustion turbine
[b] TPY Emissions are total, g/s emissions per combustion turbine

Table 5-24: Maximum Modeled Total Facility Concentrations During Startup/Shutdown Compared to Significant Impact Levels (SILs)

Pollutant	Averaging Period	Significant Impact Concentration (μg/m³)	Maximum Modeled Concentration (μg/m³)
CO	1-Hour	2,000	1,459.2[c]
	8-Hour	500	498.9[c]
NO_2	1-Hour	7.5	74.4[a,b,f]
	Annual	1	1.28[a,c]
SO_2	1-Hour	7.8	5.3[b]
	3-Hour	25	4.2[c]
	24-Hour	5	2.8[c]
	Annual	1	0.11[c]
PM-10	24-Hour	5	9.6[c]
PM-2.5	24-Hour	1.2	7.4[e]
	Annual	0.3	0.40[d]

Note:
[a]Includes use of PVMRM.
[b]Based upon maximum 1st highest maximum daily 1-hour results averaged over 5-years.
[c]Maximum modeled concentration.
[d]Maximum annual results averaged over 5-years.
[e]Based upon maximum 1st highest 24-hour results averaged over 5-years.
[f]Maximum modeled 1-hour NO_2 concentration located 0.6 km from the proposed facility.

<u>For Keasbey Energy Center</u>
1-hr and 8-hr CO, 3-hr SO_2 includes CT, AB, DFP, EDG
24-hr PM-10 and PM-2.5 includes CT, AB, DFP, EDG, cooling tower
1-hr SO_2 and 1-hr NO_2 includes CT, AB
Annual NO_2 and SO_2 includes CT, AB, DFP, EDG
Annual PM-10 and PM-2.5 includes CT, AB, DFP, EDG, cooling tower

<u>For Woodbridge Energy Center</u>
1-hr and 8-hr CO, 3-hr SO_2 includes 2CTs, AB, DFP, EDG
24-hr PM-10 and PM-2.5 includes 2CTs, AB, DFP, EDG, cooling tower
1-hr SO_2 and 1-hr NO_2 includes 2CTs, AB
Annual NO_2 and SO_2 includes 2CTs, AB, DFP, EDG
Annual PM-10 and PM-2.5 includes 2CTs, AB, DFP, EDG, cooling tower

Table 5-25: Maximum Modeled Total Facility Concentrations During Startup/Shutdown Compared to NAAQS/NJAAQS

Pollutant	Averaging Period	NAAQS/ NJAAQS (μg/m³)	Maximum Modeled Concentration (μg/m³)	Background Concentration (μg/m³)	Total Concentration (μg/m³)
CO	1-Hour	40,000	1,459.2[d]	2,415	3,874.2
	8-Hour	10,000	498.9[d]	1,495	1,993.9
NO_2	1-Hour	188	58.1[a]	57.0[b]	115.1
	Annual	100	1.28[d]	16.9	18.2[c]
SO_2	1-Hour	196	5.3[e]	12.0	17.3
	3-Hour	1,300	4.2[d]	13.9	18.1
	24-Hour	-/365	2.8[d]	5.5	8.3
	Annual	-/80	0.11[d]	0.8	0.9
PM-10	24-Hour	150	9.6[d]	33	42.6
PM-2.5	24-Hour	35	4.7[f]	18.2	22.9
	Annual	12	0.48[g]	8.1	8.6

[a]Maximum 8th highest maximum daily 1-hour results averaged over 5-years.
[b]Background concentration that was calculated for the season and hour-of-day.
[c]Includes use of PVMRM.
[d]Maximum modeled concentration.
[e]Maximum 4th highest maximum daily 1-hour results averaged over 5-years.
[f]Maximum 8th highest maximum daily 24-hour results averaged over 5-years.
[g]Maximum annual results averaged over 5-years.

Table 5-26: Total Facility Maximum Modeled Concentrations Due to Normal Operations Compared to Significant Impact Levels (SILs)

Pollutant	Averaging Period	Significant Impact Concentration (μg/m³)	Maximum Modeled Concentration (μg/m³)
CO	1-Hour	2,000	447.1[c]
	8-Hour	500	86.2[c]
SO_2	1-Hour	7.8	4.3[b]
	3-Hour	25	4.2[c]
	24-Hour	5	2.8[c]
	Annual	1	0.11[c]
PM-10	24-Hour	5	**9.6[c]**
PM-2.5	24-Hour	1.2	**7.4[e]**
	Annual	0.3	**0.41[d]**
NO_2	1-Hour	7.5	**23.1[a,b]**
	Annual	1	**1.28[a,c]**

Note:
[a]Includes use of PVMRM.
[b]Based upon maximum 1st highest maximum daily 1-hour results averaged over 5-years.
[c]Maximum modeled concentration.
[d]Maximum annual results averaged over 5-years.
[e]Based upon maximum 1st highest 24-hour results averaged over 5-years.

For Keasbey Energy Center
1-hr and 8-hr CO, 3-hr SO_2 includes CT, AB, DFP, EDG
24-hr PM-10 and PM-2.5 includes CT, AB, DFP, EDG, cooling tower
1-hr SO_2 and 1-hr NO_2 includes CT, AB, DFP, EDG
Annual NO_2 and SO_2 includes CT, AB, DFP, EDG
Annual PM-10 and PM-2.5 includes CT, AB, DFP, cooling tower

For Woodbridge Energy Center
1-hr and 8-hr CO, 3-hr SO_2 includes 2CTs, AB, DFP, EDG
24-hr PM-10 and PM-2.5 includes 2CTs, AB, DFP, EDG, cooling tower
1-hr SO_2 and 1-hr NO_2 includes 2CTs, AB, DFP, EDG
Annual NO_2 and SO_2 includes 2CTs, AB, DFP, EDG
Annual PM-10 and PM-2.5 includes 2CTs, AB, DFP, EDG, cooling tower

Table 5-27: Total Facility Maximum Modeled Concentrations Due to Normal Operations Compared to NAAQS/NJAAQS

Pollutant	Averaging Period	NAAQS/ NJAAQS (μg/m³)	Maximum Modeled Concentration (μg/m³)	Background Concentration (μg/m³)	Total Concentration (μg/m³)
CO	1-Hour	40,000	447.1[d]	2,415	2,862.1
	8-Hour	10,000	86.2[d]	1,495	1,581.2
SO_2	1-Hour	196	4.3[e]	12.0	16.3
	3-Hour	1,300	4.2[d]	13.9	18.1
	24-Hour	-/365	2.8[d]	5.5	8.3
	Annual	-/80	0.11[d]	0.8	0.9
PM-10	24-Hour	150	9.6[d]	33	42.6
PM-2.5	24-Hour	35	4.7[f]	18.2	22.9
	Annual	12	0.41[g]	8.1	8.5
NO_2	1-Hour	188	20.3[c]	72.0	92.3[c]
	Annual	100	1.28[c,d]	16.9	18.2[c]

[a]Maximum 8th highest maximum daily 1-hour results averaged over 5-years.
[b]Background concentration that was calculated for the season and hour-of-day.
[c]Includes use of PVMRM.
[d]Maximum modeled concentration.
[e]Maximum 1st highest maximum daily 1-hour results averaged over 5-years.
[f]Maximum 8th highest maximum daily 24-hour results averaged over 5-years.
[g]Maximum annual results averaged over 5-years.

Table 5-28: Total Facility Areas of Impact Due to Normal Operation

Pollutant	Averaging Period	Significant Impact Concentration (μg/m³)	Maximum Modeled Concentration (μg/m³)	Significant Impact Area (meters)
PM-2.5	24-Hour	1.2	7.4[e]	2,160
	Annual	0.3	0.41[d]	764
PM-10	24-Hour	5.0	9.6[c]	897
NO_2	1-hour	7.5	23.1[a,b]	1,266
	Annual	1	1.28[a,c]	266

[a]Includes use of PVMRM.
[b]Based upon maximum 1st highest maximum daily 1-hour results averaged over 5-years.
[c]Maximum modeled concentration.
[d]Maximum annual results averaged over 5-years.
[e]Based upon maximum 1st highest 24-hour results averaged over 5-years.

Table 5-29: Total Facility Areas of Impact Due to Startup/Shutdown Operation

Pollutant	Averaging Period	Significant Impact Concentration (µg/m³)	Maximum Modeled Concentration (µg/m³)	Significant Impact Area (meters)
PM-2.5	24-Hour	1.2	7.4[e]	2,598
	Annual	0.3	0.40[d]	809
PM-10	24-Hour	5.0	9.6[c]	897
NO_2	1-hour	7.5	74.4[a,b]	50,000+
	Annual	1	1.28[a,c]	266

[a]Includes use of PVMRM.
[b]Based upon maximum 1st highest maximum daily 1-hour results averaged over 5-years.
[c]Maximum modeled concentration.
[d]Maximum annual results averaged over 5-years.
[e]Based upon maximum 1st highest 24-hour results averaged over 5-years.

Table 5-30: Total Facility Maximum Modeled Class I Concentrations

Pollutant	Averaging Period	Class I Significant Impact Concentration (µg/m³)	Class I PSD Increment Concentration (µg/m³)	Maximum Modeled Concentration (µg/m³)
SO_2	3-Hour	1.0	25	0.112[c]
	24-Hour	0.2	5	0.032[c]
	Annual	0.1	2	0.002[c]
PM-2.5	24-Hour	0.27[a]	2	0.109[c]
	Annual	0.06	1	0.008[c]
PM-10	24-Hour	0.3	8	0.116[c]
	Annual	0.2	4	0.008[c]
NO_2	Annual	0.1	2.5	0.007[b,c]

[a]A revised 24-hour PM-2.5 Class I SIL of 0.27 µg/m³ was proposed on August 18, 2016.
[b]Includes use of PVMRM.
[c]Maximum modeled concentration.

Notes:
U.S. EPA's proposed Class I SILs for NO_2, PM-10, and SO_2 were published in the July 23, 1996, Federal Register (61 FR 38249).
U.S. EPA's PM-2.5 Class I SILs codified in 40 CFR 52.21(k)(2) were vacated.
U.S. EPA's proposed Option 3 PM-2.5 Class I SILs were published in the September 21, 2007, Federal Register (72 FR 54112).

Table 5-31: New Jersey Ambient Air Quality Standards (NJAAQS)

Pollutant	Averaging Period	Primary NJAAQS	Secondary NJAAQS
NO_2	12-Month	100 µg/m³ (0.05 ppm)	100 µg/m³ (0.05 ppm)
CO	1-hour	40,000 µg/m³ (35 ppm)	40 mg/m³ (35 ppm)
	8-hour	10,000 µg/m³ (9 ppm)	10 mg/m³ (9 ppm)
SO_2	3-hour	---	1,300 µg/m³ (0.5 ppm)
	24-hour	365 µg/m³ (0.14 ppm)	260 µg/m³ (0.10 ppm)
	12-Month	80 µg/m³ (0.03 ppm)	60 µg/m³ (0.02 ppm)
TSP	24-hour	260 µg/m³	150 µg/m³
	12-Month	75 µg/m³	60 µg/m³
Ozone	1-hour	235 µg/m³ (0.12 ppm)	157 µg/m³ (0.08 ppm)
Lead	3-month	1.5 µg/m³	1.5 µg/m³
Source: NJDEP Technical Manual 1002			

Table 5-32: Total Facility Impact on NJAAQS

Pollutant	Averaging Period	Primary NJAAQS (ug/m³)	Maximum Modeled Concentration (µg/m³)	Background Concentration (µg/m³)	Total Concentration (µg/m³)
NO_2	12-Month	100	1.28[b,d]	16.9	18.2
CO	1-hour	40,000	447.1[d]	2,415	2,862.1
	8-hour	10,000	86.2[d]	1,495	1,581.2
SO_2	3-hour	---	4.2[d]	13.9	18.1
	24-hour	365	2.8[d]	5.5	8.3
	12-Month	80	0.11[d]	0.8	0.9
TSP[a]	24-hour	260	9.6[d]	33	42.6
	12-Month	75	0.47[d]	-	0.47
Lead	3-month	1.5	0.00108[d]	-	0.00108

[a]PM10 as TSP
[b]Includes use of PVMRM.
[d]Maximum modeled concentration.

Table 5-33: Keasbey and Woodbridge Energy Centers - Air Toxics Assessment Emission Rates and Maximum Concentration

	KEC Emissions[e]		WEC Emissions[f]		Total Facility Concentrations (ug/m^3)	
Air Toxic Constituent	**lb/hr**	**tpy**	**lb/hr[b]**	**tpy[a]**	**1-Hour**	**Annual**
Acrolein	1.17E-02	0.0506	1.48E-2	0.1294	1.08E-2	4.0E-4
Ammonia	2.79E+01	122.4	15.5	126	11.34	4.6E-1
Arsenic	8.82E-04	0.00373	4.68E-4	0.0041	3.40E-4	1.0E-5
Cadmium	4.85E-03	0.0205	2.55E-3	0.0223	1.87E-3	8.0E-5
Formaldehyde	4.29E-01	1.827	3.37E-1	2.663	2.47E-1	9.3E-3
H_2SO_4	6.20E+00	26.1	3.4	7.7	2.49	3.7E-2
Hexane	7.47E-01	3.00	-[c]	-[c]	1.12E-1	2.1E-3
Lead[g]	2.20E-03	0.0093	1.40E-3	0.0102	1.08E-3[d]	3.3E-4
Mercury	1.15E-03	0.0049	7.00E-4	0.0053	5.10E-4	2.0E-5
Total POM	8.20E-03	0.0348	5.09E-3	0.0446	3.73E-3	1.6E-4
Toluene	2.40E-01	1.021	0.30	2.629	2.20E-1	8.8E-3

Notes
[a]Total Woodbridge facility tons per year.
[b]Expressed as pounds/hour per turbine.
[c]None.
[d]24-hour concentration.
[e]KEC: For 1-hour modeling, Case 11 exhaust parameters were used. For annual modeling, Cass 11 exhaust parameters were used. These cases correspond to the worst cases identified for the criteria pollutant load analysis.
[f]WEC: For 1-hour modeling, Case 7 exhaust parameters were used. For annual modeling, Case 9 exhaust parameters were used. These cases correspond to the worst cases identified for the criteria pollutant load analysis.
[g]KEC: For lead 24-hour and annual modeling, Case 11 exhaust parameters were used. WEC: For lead 24-hour and annual modeling, Case 9 exhaust parameters were used. These cases correspond to the worst cases identified for the criteria pollutant load analysis.

Table 5-33a: Keasbey and Woodbridge Energy Centers - Air Toxics Assessment Worst-Case Modeling Emissions Parameters

Averaging Period/Facility	Operating Case[a]	Amb. Temp[b] (F)	Load (%)	W/WO DB[c]	Exh. Temp[d] (K)	Exh Vel[d] (m/s)
1-hour						
Keasbey EC	Case 11	105	100	W	337.0	19.20
Woodbridge EC	Case 7	59	100	W	351.4	18.03
Annual						
Keasbey EC	Case 11	105	100	W	337.0	19.20
Woodbridge EC	Case 9	59	50	WO	345.5	11.85
Lead: 24hr & annual						
Keasbey EC	Case 11	105	100	W	337.0	19.20
Woodbridge EC	Case 9	59	50	WO	345.5	11.85

Notes:
[a] Represents worst-case operating conditions from the combustion turbine criteria pollutant load analysis.
[b] Ambient operating temperature associated with worst case.
[c] With or Without supplemental firing (duct firing) in the HRSG.
[d] Modeling exhaust temperature and exhaust outlet velocity (from the exhaust stack(s)).

Table 5-34: Total Facility Risk for Short-Term Non-Carcinogenic and Long Term Carcinogenic Effects

CAS No.	Air Toxic	Short Term Cst (ug/m³)	RfCst (ug/m³)	HQst	Rslt	Avg Period
107-02-8	Acrolein	1.08E-02	2.5	4.32E-03	**Negl.**	**1-hr**
7664-41-7	Ammonia	11.34	3200	3.54E-03	**Negl.**	**1-hr**
7440-38-2	Arsenic (inorganic)	3.40E-04	0.2	1.70E-03	**Negl.**	**1-hr**
50-32-8	Benzo(a)pyrene (as POM)	3.73E-03				**1-hr**
7440-43-9	Cadmium	1.87E-03				**1-hr**
50-00-0	Formaldehyde	2.47E-01	55	4.49E-03	**Negl.**	**1-hr**
110-54-3	Hexane (N-)	1.12E-01				**1-hr**
7439-92-1	Lead	1.08E-03	0.1	1.08E-02	**Negl.**	**24-hr**
7439-97-6	Mercury (elemental)	5.10E-04				**1-hr**
7664-93-9	Sulfuric acid	2.49	120	2.08E-02	**Negl.**	**1-hr**
108-88-3	Toluene	2.20E-01	37000	5.95E-06	**Negl.**	**1-hr**
	Total Facility			**4.6E-02**	**Negl.**	

CAS No.	Air Toxic	Clt (ug/m³)	Long Term URF [1/(ug/m³)]	IR	Rslt	Avg Period	RfC (ug/m³)	HQ	Rslt
107-02-8	Acrolein	4.0E-04				Annual	0.02	2.00E-02	**Negl.**
7664-41-7	Ammonia	4.6E-01				Annual	100	4.60E-03	**Negl.**
7440-38-2	Arsenic (inorganic)	1.0E-05	4.3E-03	4.30E-08	**Negl.**	Annual	0.015	6.67E-04	**Negl.**
50-32-8	Benzo(a)pyrene (as POM)	1.6E-04	1.1E-03	1.76E-07	**Negl.**	Annual			
7440-43-9	Cadmium	8.0E-05	4.2E-03	3.36E-07	**Negl.**	Annual	0.02	4.00E-03	**Negl.**
50-00-0	Formaldehyde	9.3E-03	1.3E-05	1.21E-07	**Negl.**	Annual	9	1.03E-03	**Negl.**
110-54-3	Hexane (N-)	2.1E-03				Annual	700	3.00E-06	**Negl.**
7439-92-1	Lead	3.3E-04	1.2E-05	3.96E-09	**Negl.**	Annual			
7439-97-6	Mercury (elemental)	2.0E-05				Annual	0.3	6.67E-05	**Negl.**
7664-93-9	Sulfuric acid	3.7E-02				Annual	1	3.70E-02	**Negl.**
108-88-3	Toluene	8.8E-03				Annual	5000	1.76E-06	**Negl.**
	Total Facility			**6.8E-07**	**Negl.**			**6.7E-02**	**Negl.**

Table 5-34: Total Facility Risk for Short-Term Non-Carcinogenic and Long Term Carcinogenic Effects (continued)

Notes:	
Clt =	Total Facility maximum 5-year average ambient air concentration
URF =	Unit risk factor (for carcinogenic risk)
IR =	C x URF = Incremental risk (for carcinogen)
RfC =	Reference concentration (for noncarcinogenic effects)
HQ =	C/RfC = Hazard quotient (for noncarcinogenic risk)
Rslt =	The result of comparing the IR or HQ to the negligible threshold (FER if > threshold, Negl. if <= threshold)
Cst =	Short-term maximum 1-hour ambient air concentration
RfCst =	Short-term reference concentration (for noncarcinogenic effects)
HQst =	Cst/RfCst = Hazard quotient for short-term noncarcinogenic effects
Rslt =	The result of comparing the HQst to the negligible threshold (FER if > threshold, Negl. if <= threshold)
Negl. =	Negligible risk

Table 5-35: Total Facility Comparison of Maximum Modeled Concentrations of Pollutants to Vegetation Screening Concentrations

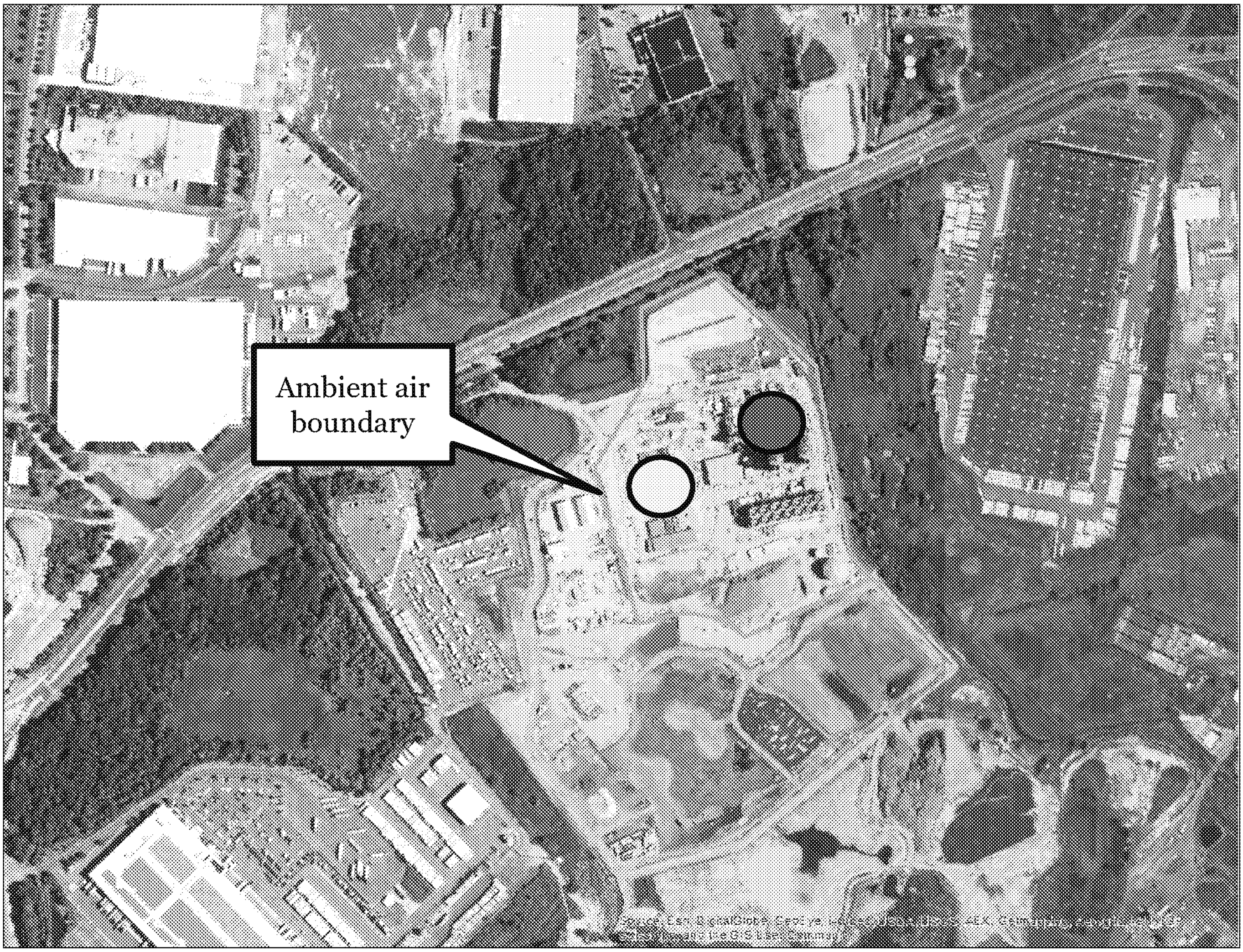
Pollutant	Averaging Period	Maximum Modeled Concentration (µg/m³)	Background Concentration (µg/m³)	Total Concentration[a] (µg/m³)	Vegetation Screening Concentrations[f] (µg/m³)		
					Sensitive	Intermediate	Resistant
SO_2	1-Hour	4.3	12.0	16.3	917	-	-
	3-Hour	4.2	13.9	18.1	786	2,096	13,100
	Annual	0.11	0.8	0.9	-	18	-
NO_2	4-Hour	23.1[b,g]	72.0	95.1	3,760	9,400	16,920
	8-Hour	23.1[b,g]	72.0[c]	95.1	3,760	7,520	15,040
	Annual	1.28[g]	16.9	18.2	-	94	-
CO	1-Week	86.2[e]	1,495[d]	1,581.2	1,800,000	-	18,000,000

[a]Total concentration = maximum modeled facility concentration + background concentration.
[b]Maximum modeled concentration conservatively based on 1-hour averaging period.
[c]Maximum background concentration conservatively based on 1-hour averaging period.
[d]Maximum background concentration conservatively based on 8-hour averaging period.
[e]Maximum modeled concentration conservatively based on 8-hour averaging period.
[f]Screening concentrations found in Table 3.1 of "A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals" (EPA, 1980).
gIncludes use of PVMRM.
(-) No screening concentration available.

Table 5-36: Total Facility VISCREEN Analysis Results

Background	Theta (degrees)	Azimuth (degrees)	Distance (km)	Alpha (degrees)	Delta E[a]		Contrast[b]	
					Criteria	Plume	Criteria	Plume
Inside Surrounding Area								
Sky	10.	84.	30.0	84.	3.79	0.072	0.06	0.001
Sky	140.	84.	30.0	84.	2.00	0.028	0.06	-0.001
Terrain	10	84.	30.0	84.	3.51	0.087	0.06	0.001
Terrain	140.	84.	30.0	84.	2.00	0.017	0.06	0.001
Outside Surrounding Area								
Sky	10.	0.	1.0	168.	2.00	0.166	0.05	0.002
Sky	140.	0.	1.0	168.	2.00	0.032	0.05	-0.002
Terrain	10.	0.	1.0	168.	2.00	0.315	0.05	0.003
Terrain	140.	0.	1.0	168.	2.00	0.090	0.05	0.003

[a]Color difference parameter (dimensionless).
[b]Visual contrast against background parameter (dimensionless).



Keasbey Energy Center Location

Woodbridge Energy Center Location

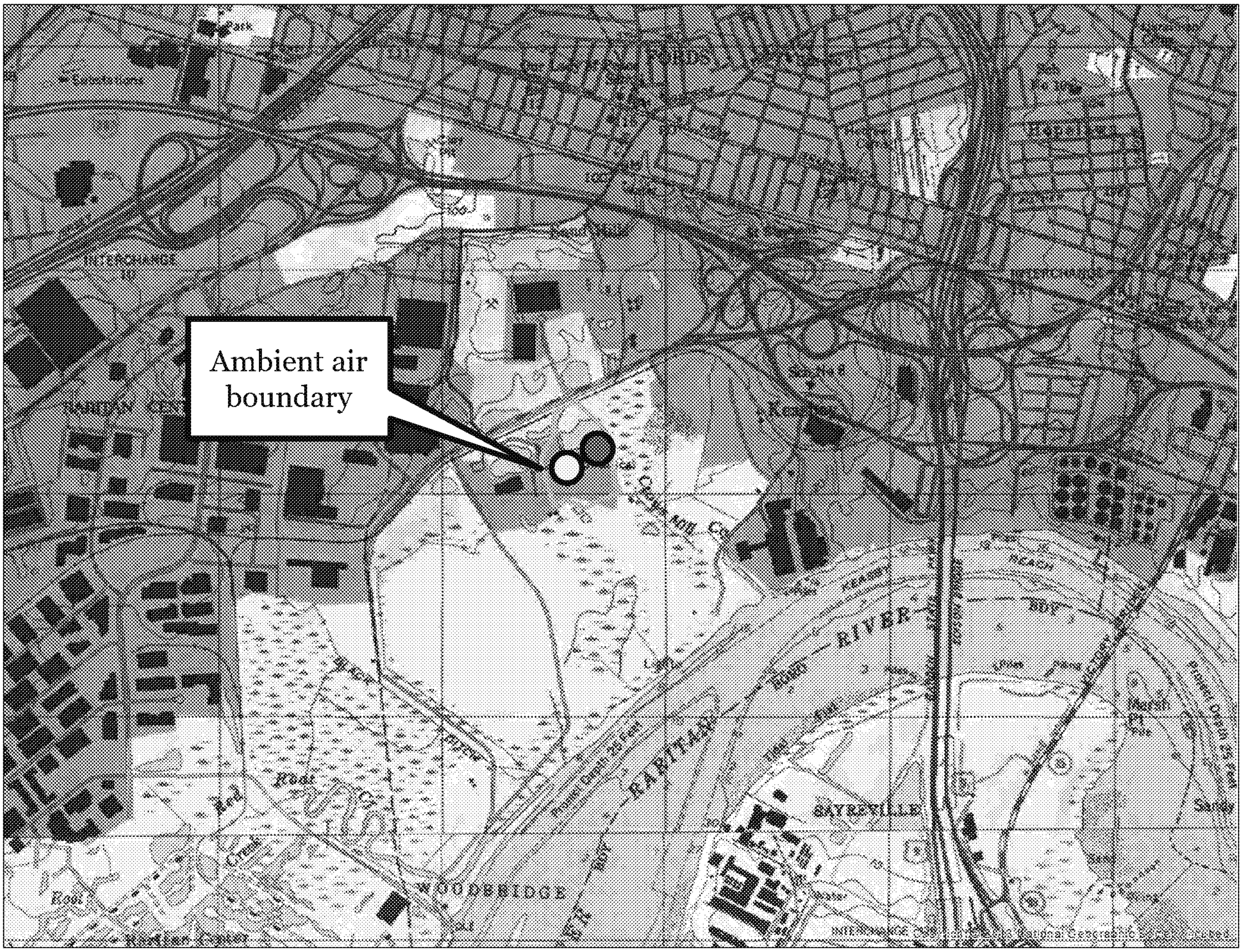
TRC
1099 Wall St. West, Suite 250B
Lyndhurst, NJ 07071
201-933-5541

SITE LOCATION MAP

MAP OF THE KEASBEY ENERGY CENTER SITE

**CPV KEASBEY, LLC
WOODBRIDGE, NEW JERSEY**

FIGURE 5-1	**JANUARY 2021**



Note: The red regions denote developed areas of medium intensity (i.e., single family housing units) and high intensity (i.e., apartments, row houses, and commercial/industrial).

Keasbey Energy Center Location

Woodbridge Energy Center Location

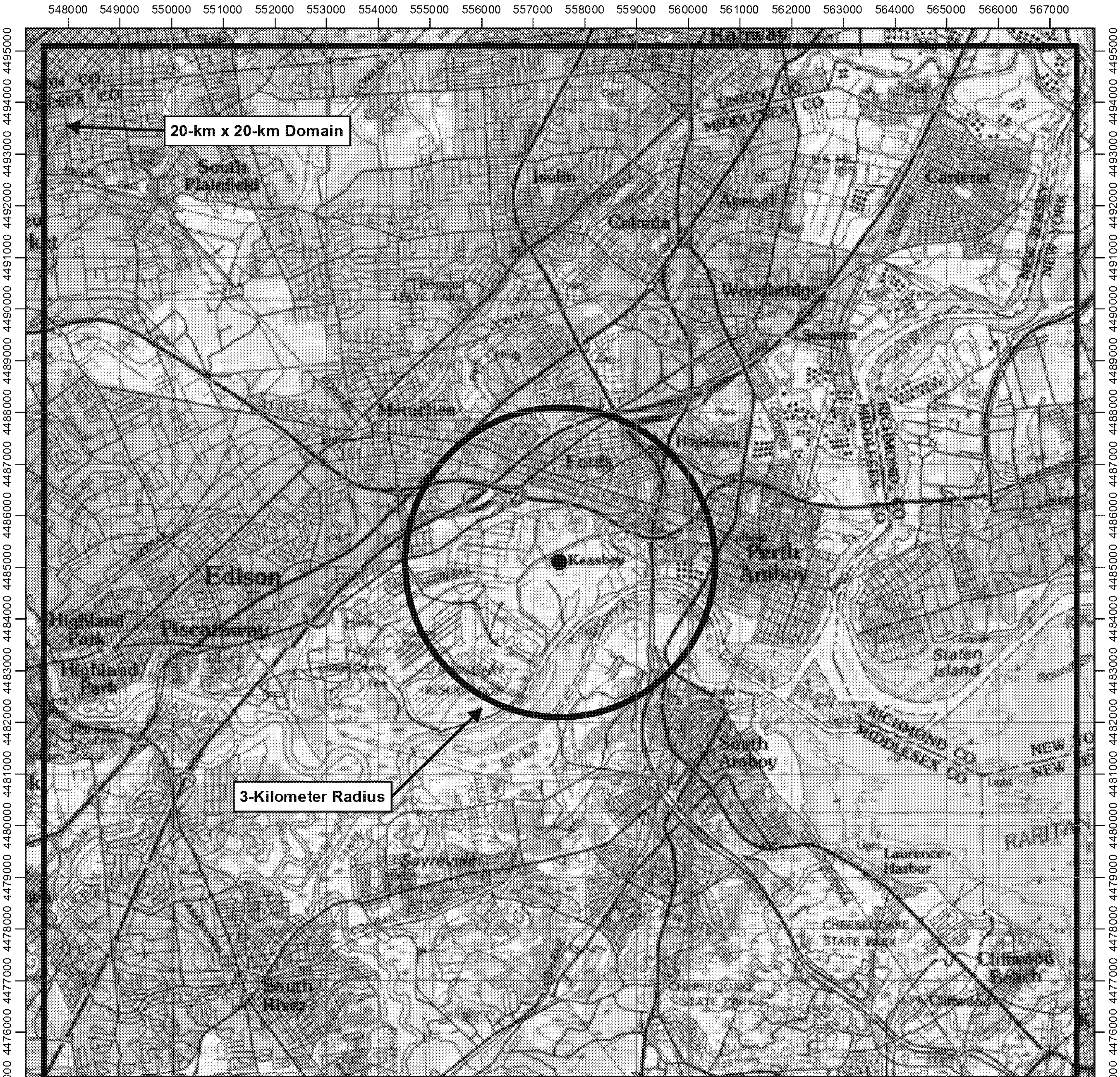
TRC 1099 Wall St. West, Suite 250B
Lyndhurst, NJ 07071
201-933-5541

SITE LOCATION MAP

MAP OF THE KEASBEY ENERGY CENTER SITE

CPV KEASBEY, LLC
WOODBRIDGE, NEW JERSEY

FIGURE 5-2	JANUARY 2021



Site Location

N

0 1,000 2,000 Meters

Base Map: USGS

TRC
Wannalancit Mills
650 Suffolk Street
Lowell, MA 01854
978-970-5600

FULL MODELING DOMAIN AND 3-KM RADIUS AROUND THE PROJECT SITE

KEASBEY ENERGY CENTER
WOODBRIDGE, NEW JERSEY

FIGURE 5-3a	July 2016

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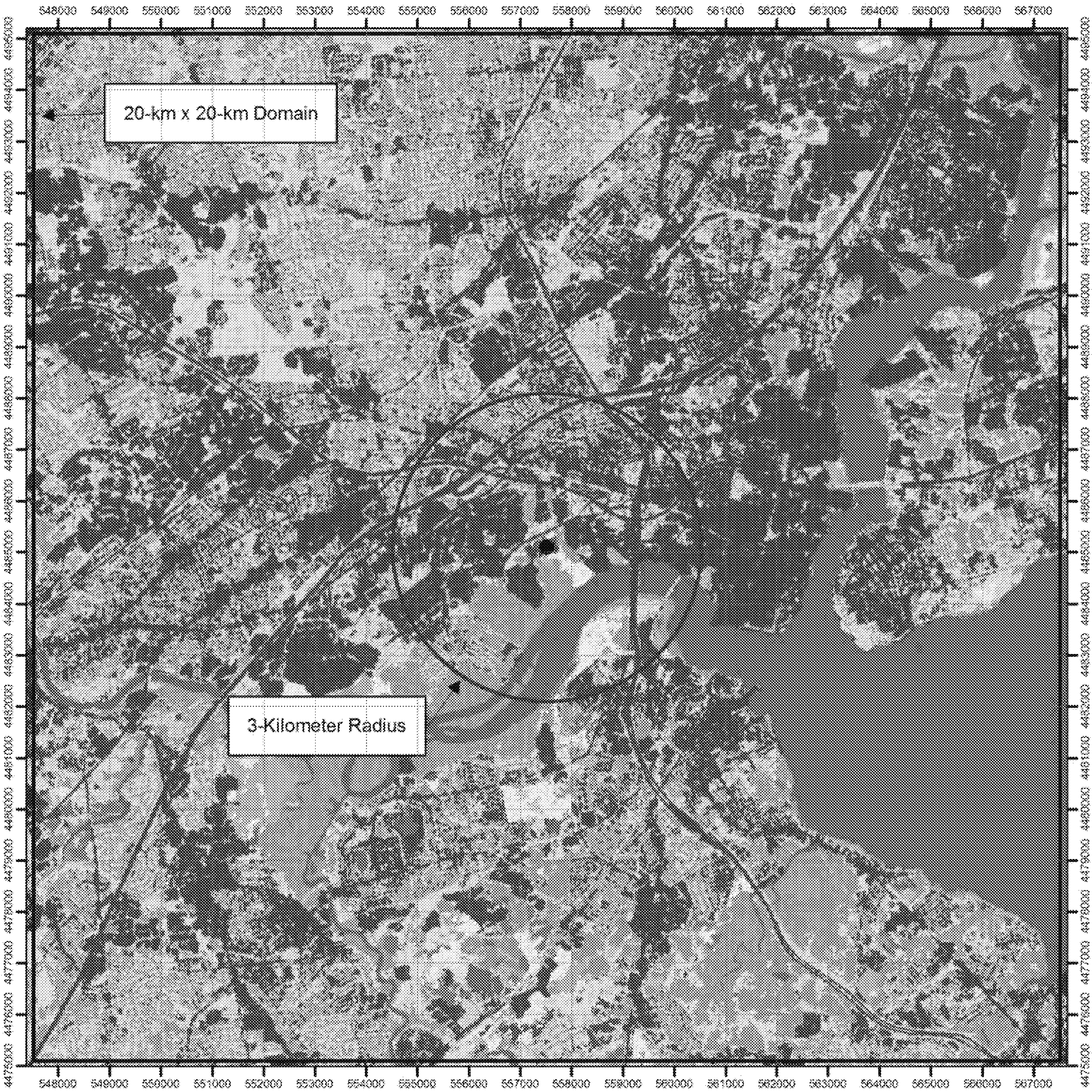

● Site Location

2011 NLCD Cat23 + Cat24

11 - Open Water
21 - Developed, Open Space
22 - Developed, Low Intensity
23 - Developed, Medium Intensity
24 - Developed, High Intensity
31 - Barren Land
41 - Deciduous Forest
42 - Evergreen Forest
43 - Mixed Forest
52 - Shrub/Scrub
71 - Grassland/Herbaceous
81 - Pasture/Hay
82 - Cultivated Crops
90 - Woody Wetlands
95 - Emergent Herbaceous Wetlan

N

0 1,000 2,000 Meters

Base Map: USGS

TRC
Wannalancit Mills
650 Suffolk Street
Lowell, MA 01854
978-970-5600

FULL MODELING DOMAIN AND 3-KM RADIUS AROUND THE PROJECT SITE

KEASBEY ENERGY CENTER WOODBRIDGE, NEW JERSEY

FIGURE 5-3b	**November 2016**

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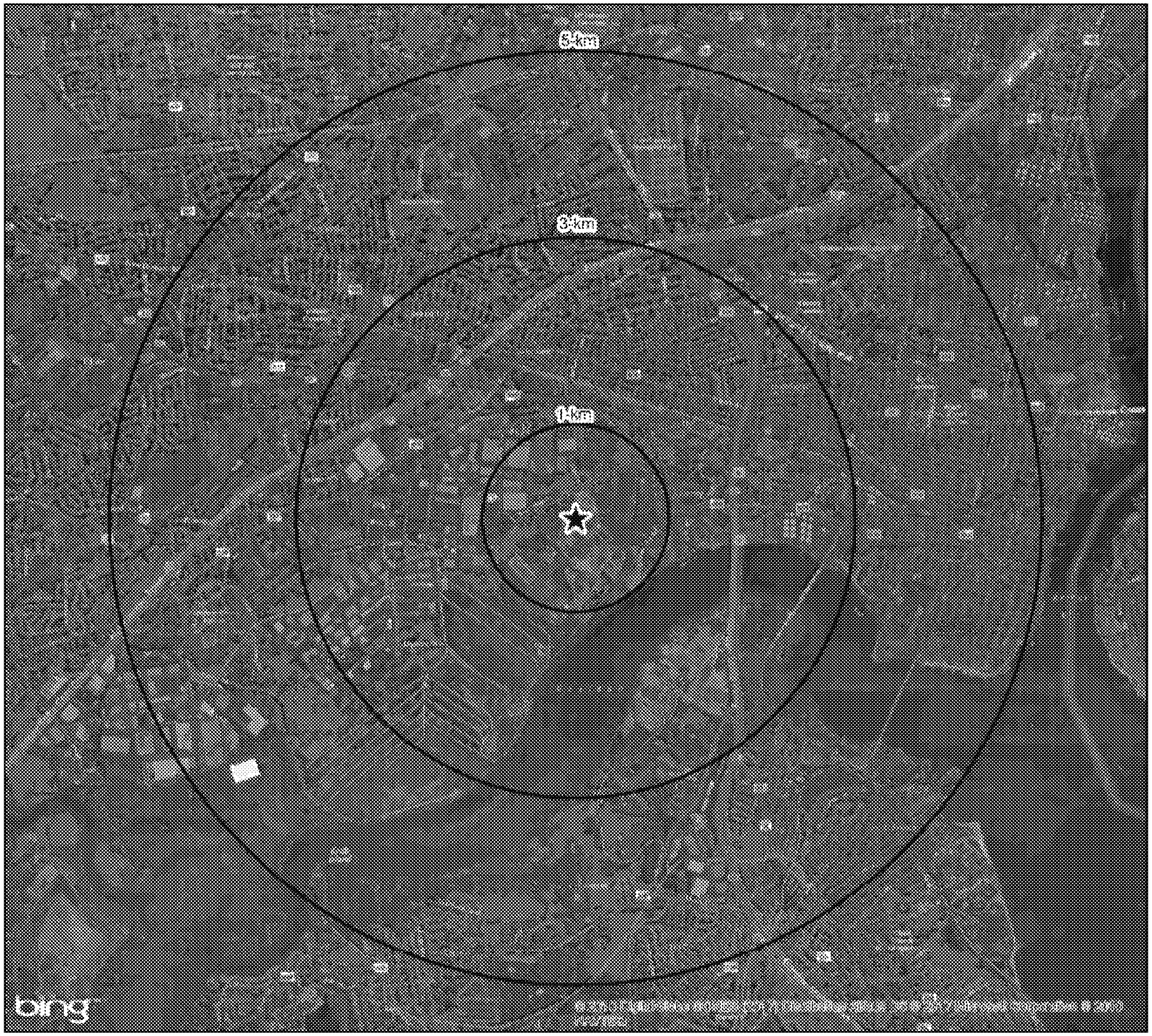


★ CPV Keasbey

Impervious

Value

0 - 49.999

49.99900001 - 999

Canopy

Value

0 - 39.9999

39.99990001 - 999,999

Keasbey Energy Center
Proposed Combined Cycle Power Facility
Township of Woodbridge, Middlesex County, New Jersey

Figure 5-3c. Percent Impervious Surface and Canopy

Source: NLCD 2011

TRC

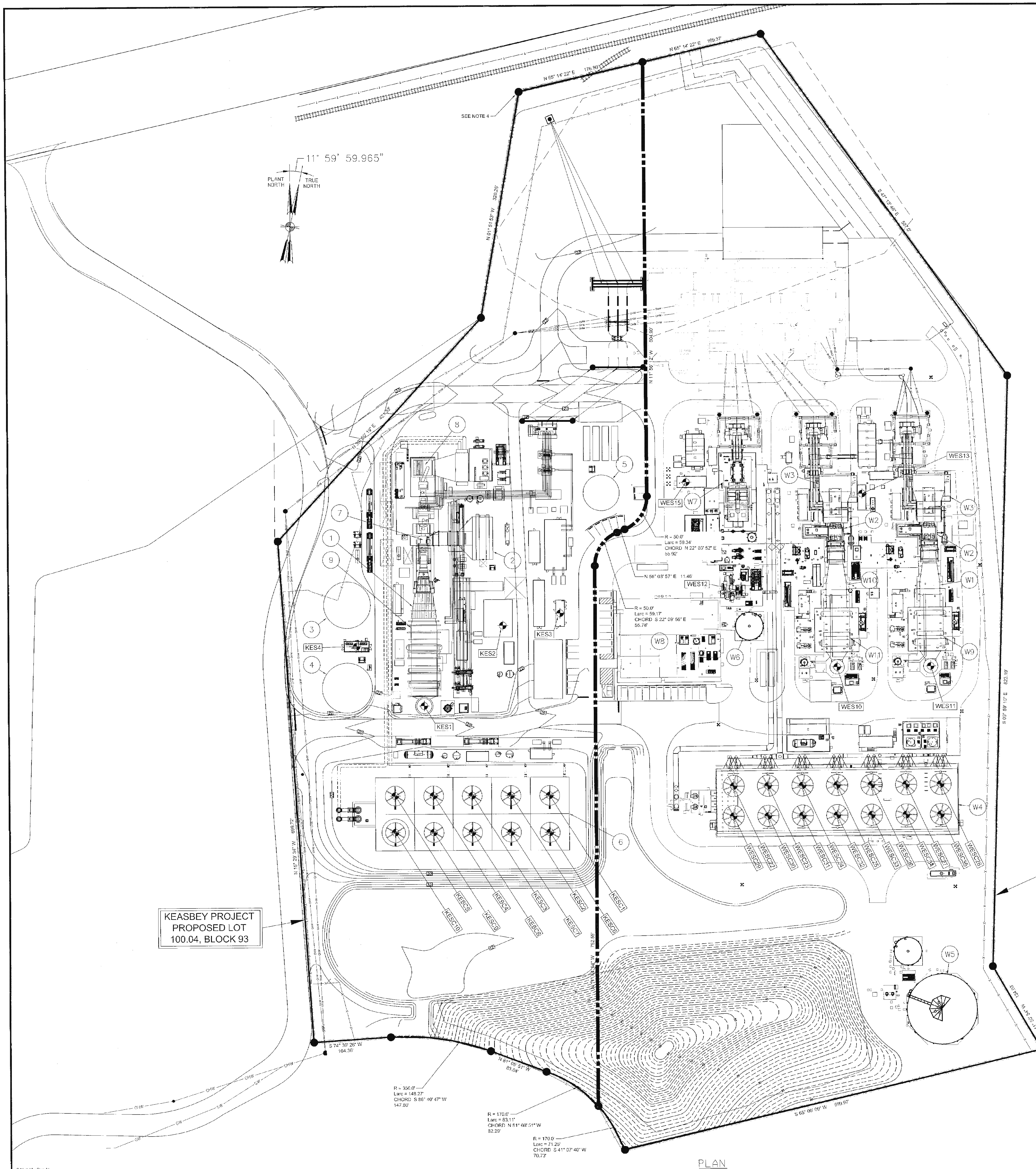


Figure 5-4: General Arrangement Plan

KEASBEY EMISSION SOURCE (KES)					
POINT	EQUIPMENT	DATA (US FEET)		UTM NAD 83 ZONE 18 (US FEET)	
		HEIGHT	BASE ELEVATION	N	E
KES1	HRSG STACK	160	22.5	14,714,866.903	1,829,113.551
KES2	AUX BOILER	40	22.5	14,714,998.975	1,829,198.173
KES3	DIESEL GENERATOR	20	22.5	14,715,031.968	1,829,272.732
KES4	DIESEL FIRE PUMP	26	22.5	14,714,928.742	1,829,004.280
KESC1	COOLING TOWER	54	22.5	14714780.809	1829310.162
KESC2	COOLING TOWER	54	22.5	14714769.583	1829257.356
KESC3	COOLING TOWER	54	22.5	14714758.358	1829204.550
KESC4	COOLING TOWER	54	22.5	14714747.132	1829151.744
KESC5	COOLING TOWER	54	22.5	14714735.907	1829098.938
KESC6	COOLING TOWER	54	22.5	14714730.494	1829320.858
KESC7	COOLING TOWER	54	22.5	14714719.711	1829267.958
KESC8	COOLING TOWER	54	22.5	14714708.486	1829215.152
KESC9	COOLING TOWER	54	22.5	14714697.260	1829162.346
KESC10	COOLING TOWER	54	22.5	14714686.034	1829109.540

WOODBRIDGE EMISSION SOURCE (WES)					
POINT	EQUIPMENT	DATA (US FEET)		UTM NAD 83 ZONE 18 (US FEET)	
		HEIGHT	GRADE ELEVATION	N	E
WES10	HRSG STACK	145	19.5	14,715,037.516	1,829,665.792
WES11	HRSG STACK	145	19.5	14,715,065.289	1,829,792.754
WES12	AUX BOILER	40	19.5	14,715,113.663	1,829,509.953
WES13	EMERGENCY DIESEL GENERATOR	30	19.5	14,715,280.831	1,829,650.533
WES15	DIESEL FIRE PUMP	20	19.5	14,715,246.385	1,829,407.111
WESC22	COOLING TOWER	55	19.5	14,714,845.665	1,829,558.343
WESC23	COOLING TOWER	55	19.5	14,714,855.920	1,829,605.222
WESC24	COOLING TOWER	55	19.5	14,714,866.176	1,829,652.103
WESC25	COOLING TOWER	55	19.5	14,714,876.428	1,829,698.981
WESC26	COOLING TOWER	55	19.5	14,714,886.684	1,829,745.860
WESC27	COOLING TOWER	55	19.5	14,714,896.940	1,829,792.740
WESC28	COOLING TOWER	55	19.5	14,714,907.193	1,829,839.618
WESC29	COOLING TOWER	55	19.5	14,714,804.557	1,829,566.900
WESC30	COOLING TOWER	55	19.5	14,714,814.752	1,829,614.195
WESC31	COOLING TOWER	55	19.5	14,714,825.156	1,829,661.075
WESC32	COOLING TOWER	55	19.5	14,714,835.411	1,829,707.954
WESC33	COOLING TOWER	55	19.5	14,714,845.664	1,829,754.832
WESC34	COOLING TOWER	55	19.5	14,714,855.920	1,829,801.712
WESC35	COOLING TOWER	55	19.5	14,714,866.175	1,829,848.591

KEASBEY BPIP STRUCTURE DIMENSIONS
(SEE NOTE 9 + 10)

MARK		LENGTH (FT)	WIDTH (FT)	DIAMETER (FT)	HEIGHT (FT)
1	HRSG TIER 1	104	40	-	64.5
2	INLET AIR FILTER	60	29	-	44
3	OIL TANK	-	-	65	50
4	RECLAIM WATER TANK	-	-	70	60
5	DEMIN WATER TANK	-	-	50	40
6	COOLING TOWER STRUCTURE	102	271	-	40
7	CT	79	30	-	31
8	ST ENCLOSURE	55	54	-	46
9	HRSG TIER 2	104	37	-	94

WOODBRIDGE BPIP STRUCTURE DIMENSIONS

MARK		LENGTH (FT)	WIDTH (FT)	DIAMETER (FT)	HEIGHT (FT)
W1	HRSG 1 TIER 1	61	62	-	49
W2	CT	56	25	-	30
W3	INLET AIR FILTER	44	25	-	81.75
W4	COOLING TOWER STRUCTURE	90	336	-	41.85
W5	RECLAIM WATER TANK	-	-	89	37
W6	DEMIN WATER TANK	-	-	39	24.18
W7	ST ENCLOSURE	99	39	-	44
W8	WAREHOUSE	110	140	-	25
W9	HRSG 1 TIER 2	61	62	-	95
W10	HRSG 2 TIER 1	61	62	-	49
W11	HRSG 2 TIER 2	61	62	-	95

Notes

1. UNLESS NOTED OTHERWISE, ALL EXISTING SITE DATA, AND PROPOSED KEASBEY SITE GRADING DATA SHOWN, HERE-IN IS BASED ON THE SITE SURVEY FILES AND PRELIMINARY SITE LAYOUT DRAWINGS PREPARED BY CME ASSOCIATES, PARLIN, NEW JERSEY, RECEIVED DECEMBER 2016.
2. THE PROPERTY DATA SHOWN FOR THE KEASBEY SITE IS BASED ON THE DESCRIPTION OF PROPOSED LOT 100.04, BLOCK 93, BEING A PORTION OF LOT 100.02, PREPARED BY CME ASSOCIATES, PARLIN, NEW JERSEY DATED, PRELIMINARY 2016, AND REFERENCED TO THE NEW JERSEY STATE PLANE COORDINATE BEARING SYSTEM NAD83.
3. THE PROPERTY DATA SHOWN FOR THE WOODBRIDGE SITE IS BASED ON THE DESCRIPTION OF PROPOSED LOT 100.03, BLOCK 93, BEING A PORTION OF LOT 100.02, PREPARED BY CME ASSOCIATES, PARLIN, NEW JERSEY DATED, PRELIMINARY 2016, AND REFERENCED TO THE NEW JERSEY STATE PLANE COORDINATE BEARING SYSTEM NAD83.
4. THE PROJECT PROPERTY BOUNDARY LOCATION IN THE NEW JERSEY STATE PLANE COORDINATE SYSTEM NAD83 IS BASED ON THE N 613,295.1994 AND E 541,827.8174 COORDINATES SHOWN AT THE NORTH WEST CORNER OF THE SITE BOUNDARY ON THE SURVEY & MINOR SUBDIVISION SKETCH THROUGH LOTS 2 & 3, BLOCK 62, & LOT 100, BLOCK 93, N/F EPEC POLYMERS INC, FILE NO. PYR05293.02, DRAWING NO. 03-T, REV 6 MARCH 20, 2013, PREPARED BY CME ASSOCIATES, PARLIN, NEW JERSEY.
5. COORDINATES FOR EMISSION SOURCES AND STRUCTURES SHOWN HERE-IN ARE REFERENCED TO UTM [NAD83] ZONE 18 IN US FEET.
6. THE 11° 59' 59.965" OFFSET BETWEEN TRUE NORTH AND PLANT NORTH IS BASED ON THE CONSTRUCTION SURVEY CONTROL PLAN, DRAWING 2013-012-CT-001, REV 1, DATED MARCH 6, 2014, PREPARED BY KIEWIT POWER FOR THE ADJACENT SHORE WOODBRIDGE PROJECT.
7. GRADE ELEVATIONS SHOWN ARE IN FEET AND REFERENCED TO NAVD 88.
8. THE COORDINATES FOR THE KEASBEY AND WOODBRIDGE EMISSION SOURCES ARE BASED ON THE GRAPHICAL LOCATION SHOWN IN THE ELECTRONIC CME FILES: AND CONVERTED FROM NEW JERSEY STATE PLANE NAD83 TO UTM ZONE 18 NAD83 IN FEET.
9. STRUCTURAL AND EQUIPMENT DIMENSIONS FOR THE KEASBEY PROJECT ARE APPROXIMATE.
10. THE STRUCTURES IDENTIFIED ON THE DRAWING WITH THEIR RESPECTIVE DIMENSIONS ARE INCLUDED IN THE BPIP ANALYSIS. ITEMS NOT IDENTIFIED ON THE DRAWING ARE ANTICIPATED TO BE NO TALLER THAN 35 FEET AND AS SUCH WOULD NOT IMPACT THE BPIP BUILDING DOWNWASH CALCULATIONS.

Legend

PROPERTY LINE
FENCE
ROADS
PROPOSED GRADES
EXISTING GRADES
STRUCTURES
STRUCTURE MARK
KEASBEY EMISSION SOURCE
WOODBRIDGE EMISSION SOURCE
ES LOCATION

Reference Drawings

Rev	Date	Drawn	Description	Ch'k'd	App'd
D	04/04/17	AF	FOR AIR PERMIT	MFL	--
C	02-24-17	AF	FOR CLIENT REVIEW	MFL	--
B	02-16-17	DSP	FOR CLIENT REVIEW	MFL	--
A	02-08-17	DSP	FOR CLIENT REVIEW	MFL	--

Mott MacDonald
One University Avenue
Suite 100, North Lobby
Westwood, MA 02090
United States
T +1 (781) 915-0015
F +1 (781) 915-0001
W www.mottmac.com

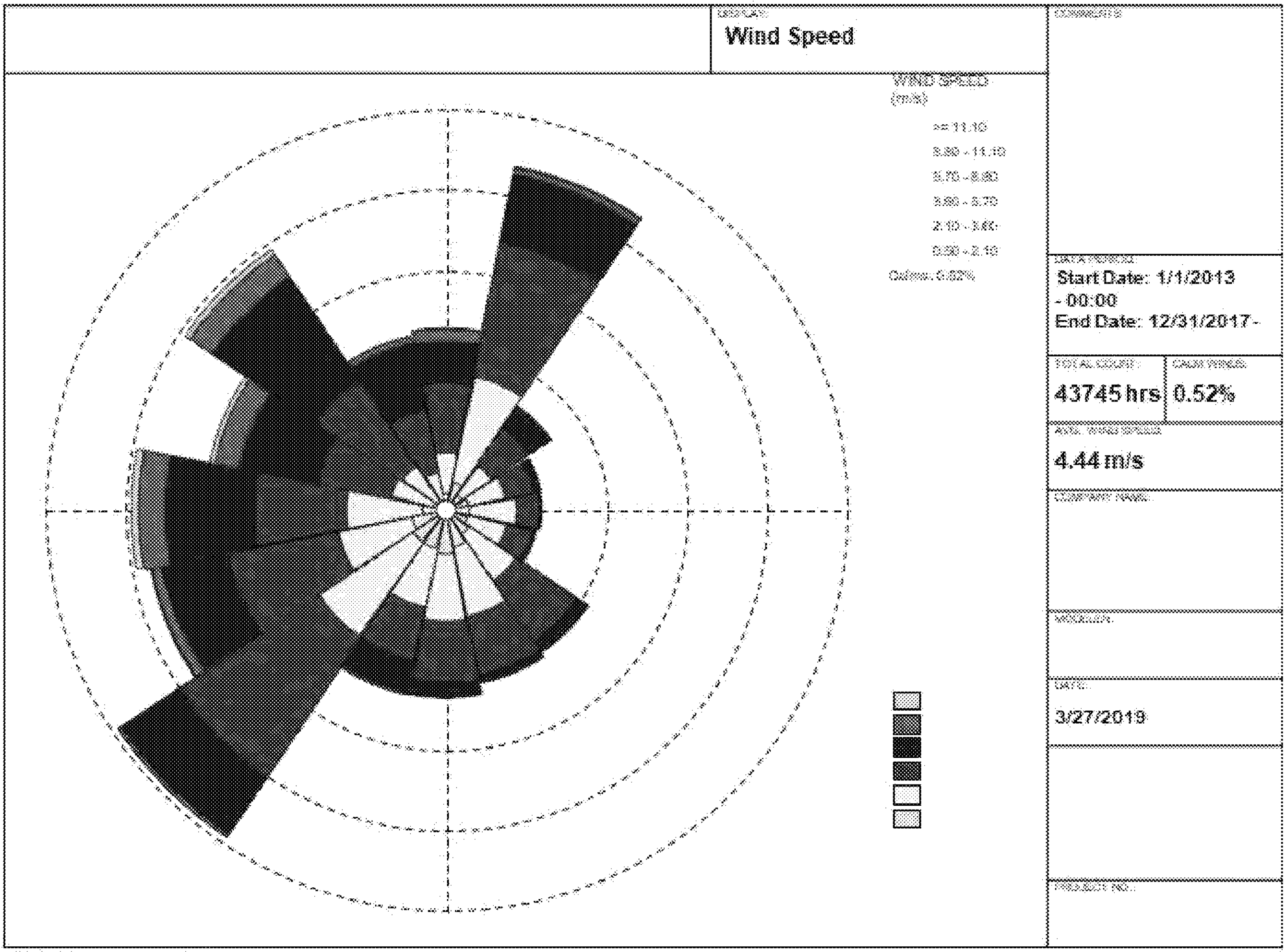
Client
Competitive Power Ventures, Inc.

Title
KEASBEY / WOODBRIDGE
NEW JERSEY
SITE ARRANGEMENT
EMISSION SOURCE

4-4-2017

Designed	MFL	Eng check	MFL
Drawn	DSP	Approved	SEK
Dwg check	MFL	Project Mngr	KP
Scale at ANSI E: 1" = 50'-0"		Date: 01/03/17	Rev: D

Drawing Number
324698-ES-702



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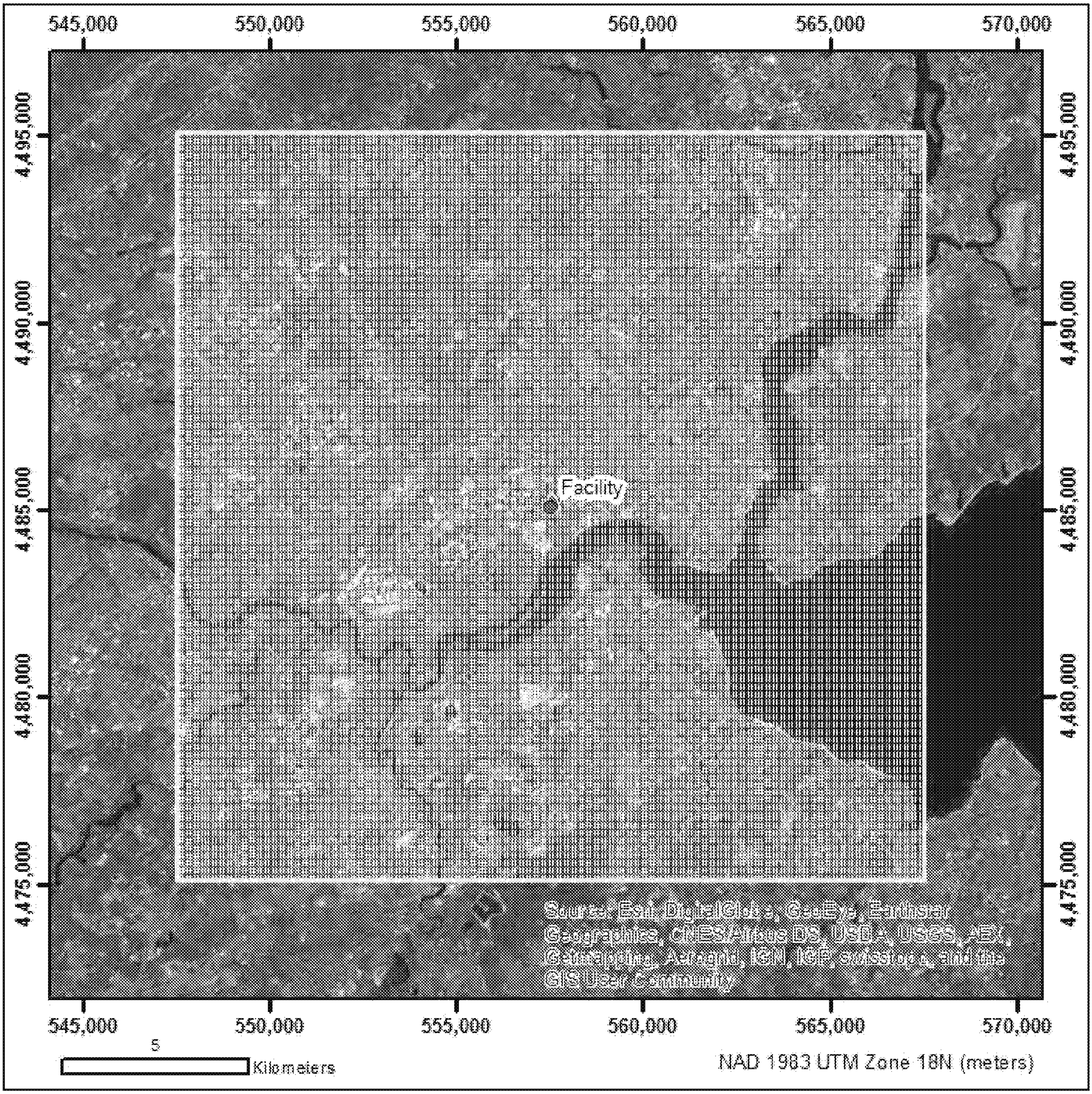
Lyndhurst, NJ 07071
201-933-5541

WIND ROSE FOR NEWARK LIBERTY INTERNATIONAL AIRPORT (2013 – 2017)

CPV KEASBEY, LLC
WOODBRIDGE, NEW JERSEY

FIGURE 5-5	JANUARY 2021



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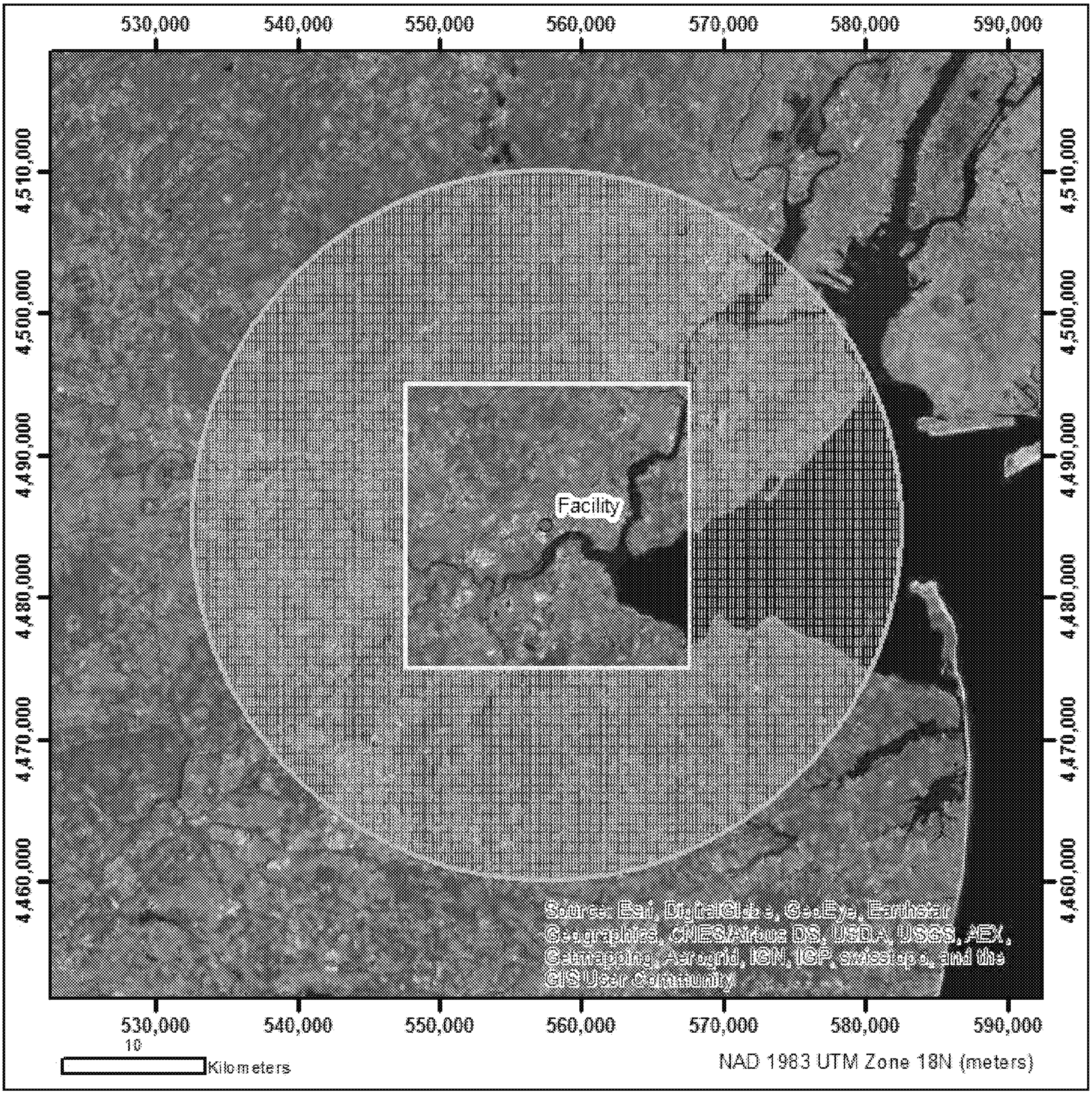
20 KM X 20 CARTESIAN RECEPTOR GRID (100 METER SPACING)

CPV KEASBEY, LLC
WOODBRIDGE, NEW JERSEY

FIGURE 5-6	**MAY 2021**



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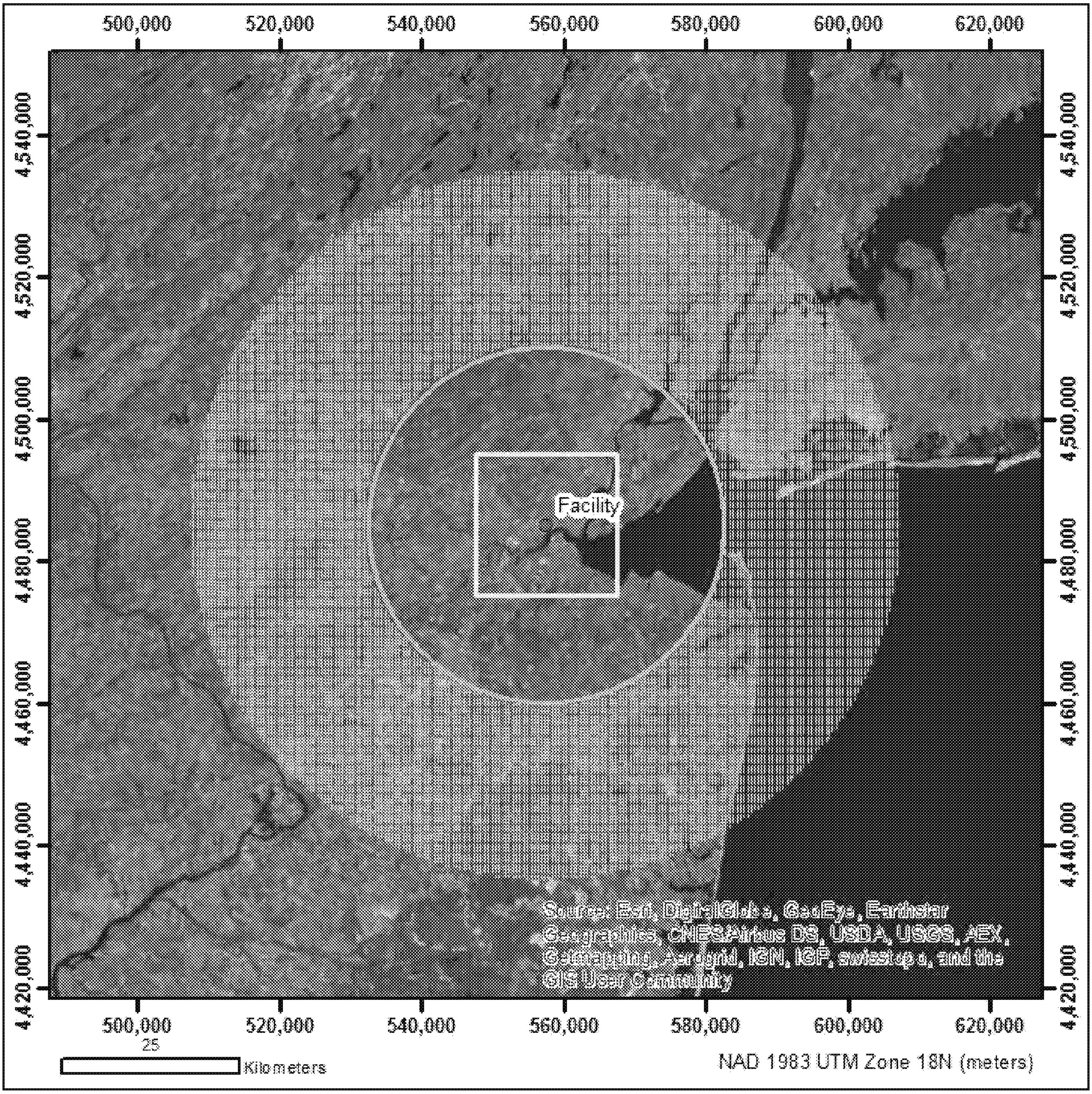
RECEPTOR GRID (250 METER SPACING) OUT TO 25 KM

CPV KEASBEY, LLC
WOODBRIDGE, NEW JERSEY

FIGURE 5-7	**MAY 2021**



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RECEPTOR GRID (500 METER SPACING) OUT TO 50 KM

CPV KEASBEY, LLC
WOODBRIDGE, NEW JERSEY

FIGURE 5-8	**MAY 2021**

Figure 5-8a: Background NO_2 and Ozone Monitor Locations

Keasbey Energy Center Location

Maximum Modeled Concentration (9.6 ug/m^3)

Concentration > 5 ug/m^3

TRC
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201-933-5541

24-HOUR PM-10 MAXIMUM MODELED CONCENTRATION ISOPLETHS – NORMAL OPERATIONS

CPV KEASBEY, LLC
WOODBRIDGE, NEW JERSEY

FIGURE 5-9	**MAY 2021**

Keasbey Energy Center Location

Maximum Modeled Concentration (7.4 ug/m^3)

Concentration > 1.2 ug/m^3

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201-933-5541

24-HOUR PM-2.5 MAXIMUM MODELED CONCENTRATION ISOPLETHS – NORMAL OPERATIONS

CPV KEASBEY, LLC
WOODBRIDGE, NEW JERSEY

FIGURE 5-10	MAY 2021

Keasbey Energy Center Location

Maximum Modeled Concentration (23.1 ug/m^3)

Concentration > 7.5 ug/m^3

TRC
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201-933-5541

1-HOUR NO2 MAXIMUM MODELED CONCENTRATION ISOPLETHS – NORMAL OPERATIONS

CPV KEASBEY, LLC
WOODBRIDGE, NEW JERSEY

FIGURE 5-11	MAY 2021

Keasbey Energy Center Location

Maximum Modeled Concentration (1.3 ug/m^3)

Concentration > 1 ug/m^3

TRC
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201-933-5541

ANNUAL NO2 MAXIMUM MODELED CONCENTRATION ISOPLETHS – NORMAL OPERATIONS

CPV KEASBEY, LLC
WOODBRIDGE, NEW JERSEY

FIGURE 5-12	MAY 2021

Keasbey Energy Center Location

Maximum Modeled Concentration (0.4 ug/m^3)

Concentration > 0.3 ug/m^3

TRC 1099 Wall St. West, Suite 250B
Lyndhurst, NJ 07071
201-933-5541

ANNUAL PM-2.5 MAXIMUM MODELED CONCENTRATION ISOPLETHS – NORMAL OPERATIONS

CPV KEASBEY, LLC
WOODBRIDGE, NEW JERSEY

FIGURE 5-13	**MAY 2021**

Keasbey Energy Center Location

Maximum Modeled Concentration (9.6 ug/m^3)

Concentration > 5 ug/m^3

TRC
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24-HOUR PM-10 MAXIMUM MODELED CONCENTRATION ISOPLETHS – INCLUDES SUSD OPERATIONS

CPV KEASBEY, LLC
WOODBRIDGE, NEW JERSEY

FIGURE 5-14 | **MAY 2021**

Keasbey Energy Center Location

Maximum Modeled Concentration ($7.4\ ug/m^3$)

Concentration > $1.2\ ug/m^3$

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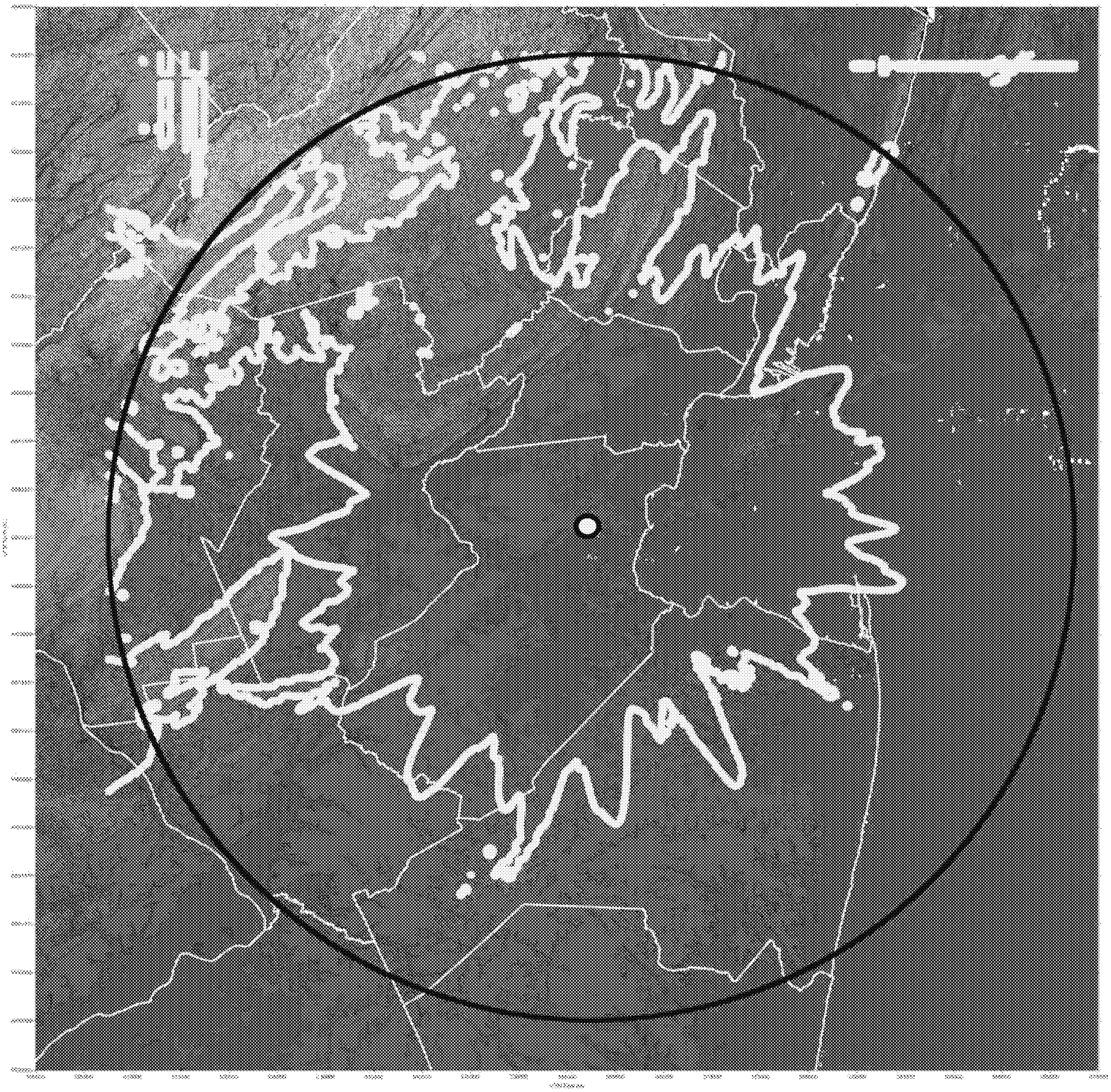
201-933-5541

24-HOUR PM-10 MAXIMUM MODELED CONCENTRATION ISOPLETHS – INCLUDES SUSD OPERATIONS

CPV KEASBEY, LLC
WOODBRIDGE, NEW JERSEY

FIGURE 5-15 | **MAY 2021**



Keasbey Energy Center Location

Maximum Modeled Concentration ($74.4\ ug/m^3$)

Concentration > $7.5\ ug/m^3$

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Lyndhurst, NJ 07071
201-933-5541

1-HOUR NO2 MAXIMUM MODELED CONCENTRATION ISOPLETHS – INCLUDES SUSD OPERATIONS

CPV KEASBEY, LLC
WOODBRIDGE, NEW JERSEY

FIGURE 5-16	**MAY 2021**

Keasbey Energy Center Location

Maximum Modeled Concentration (1.3 ug/m^3)

Concentration > 1 ug/m^3

TRC
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201-933-5541

ANNUAL NO2 MAXIMUM MODELED CONCENTRATION ISOPLETHS – INCLUDES SUSD OPERATIONS

CPV KEASBEY, LLC
WOODBRIDGE, NEW JERSEY

FIGURE 5-17	MAY 2021

Keasbey Energy Center Location

Maximum Modeled Concentration (0.4 ug/m^3)

Concentration > 0.3 ug/m^3

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Lyndhurst, NJ 07071
201-933-5541

ANNUAL PM-2.5 MAXIMUM MODELED CONCENTRATION ISOPLETHS – INCLUDES SUSD OPERATIONS

CPV KEASBEY, LLC
WOODBRIDGE, NEW JERSEY

FIGURE 5-18	MAY 2021

APPENDIX D

AGENCY CORRESPONDENCE

State of New Jersey
Department of Environmental Protection
Air Quality, Energy and Sustainability
Division of Air Quality
Bureau of Evaluation and Planning
401 E. State Street, 2nd Floor, P.O. Box 420, Mail Code 401-02
Trenton, NJ 08625-0420

PHILIP D. MURPHY
Governor

SHEILA Y. OLIVER
Lt. Governor

SHAWN M. LATOURETTE
Acting Commissioner

April 19, 2021

Mr. Darin Ometz
Senior Air Quality Project Manager
TRC
1099 Wall Street West, Suite 250B
Lyndhurst, NJ 07071

SUBJECT: CPV Keasbey, LLC
Approval of Air Quality Modeling Protocol (Revision 3, dated February 2021)
Woodbridge, Middlesex County, New Jersey
PI# 18940, BOP#160004

Dear Mr. Ometz,

The NJDEP Bureau of Evaluation and Planning (BEP) in collaboration with USEPA Region 2 has completed its review of the above referenced document. The protocol is conditionally approved provided the attached comments are properly addressed in the air quality modeling report. If you have any questions, please contact me at Yiling.Zhang@dep.nj.gov, or Greg John at Greg.John@dep.nj.gov.

Sincerely,

Yiling Zhang

Yiling Zhang
Research Scientist

c: J. Leon, BSS
D. Owen, BSS
A. Khan, BSS
G. John, BEP
A. Colecchia, EPA-R2
N. Sareen, EPA-R2
Darin Ometz, TRC
Michael Keller (TRC)

General Comment

1. A general recommendation is to include links to guidance that are cited in the protocol and future reports.

Section 3.2 Fuels

2. Per BEP Comment Q3 of December 8, 2016, Keasbey added two paragraphs on how natural gas sulfur content was determined in its March 2017 modeling protocol. These two paragraphs were removed from the February 2021 protocol Revision 3 and should be added back to this updated modeling protocol.

BEP acknowledges that the proposed pipeline sulfur content has been revised from 0.63 to 0.75 grain per 100 scf.

Section 3.3 Operation

3. It has been established during the previous protocol review that Keasbey's air quality impact analysis will include PSD Class I increments. This section only referred to Class II increments.

Section 3.4 Selection of Sources for Modeling

4. This section states that "*The emergency equipment may operate for up to one hour per day for readiness testing and maintenance purposes.*"

Other sections of the protocol referred to testing the emergency equipment not more than once per week (with test durations limited by permit condition to no more than 30 minutes) and 100 hours per year per equipment.

Section 3.5 Exhaust Stack Configuration and Emission Parameters (Keasbey Energy Center)

5. In Table 3-2 and subsequent tables, there is a missing footnote for the "a" next to PM-10/PM-2.5.

6. Section 3.5.3: For the MERPS analysis, please justify the use of the hypothetical source in Bronx, NY instead of the more rural source in Warren, NJ.

Information that could be used to describe the comparability of two different geographic areas include: nearby local and regional sources of pollutants and their emissions (e.g., other industry, mobile, biogenics), rural or urban nature of the area, terrain, ambient concentrations of relevant pollutants where available, average and peak temperatures, humidity.

From Section 4 of the MERPS guidance:
The permit applicant should provide the appropriate permitting authority with a technically credible justification that the source characteristics (e.g., stack height, emissions rate) of the specific project source described in a permit application and the chemical and physical environment (e.g., meteorology, background pollutant concentrations, and regional/local emissions) near that project source are adequately represented by the selected hypothetical source(s).

Section 4.1.3 Preconstruction Ambient Air Quality Monitoring Exemption

7. For the preconstruction monitoring waiver, it is recommended that the applicant include a note if there has been any additional activity in the area since the approved waiver in 2016.

Section 4.2 New Jersey Department of Environmental Protection Regulations

8. The applicant can remove ULSD from the 1st bullet and remove combustion turbine from the list of equipment.

Section 5.1 Model Selection

9. A new AERMOD version is expected to be released later this Spring. The new model version should be used unless the applicant can discuss that the new model version will not affect any of the modeling scenarios or results.

Section 5.2 Surrounding Area and Land Use

10. Please include the version of AERSURFACE and the land use years used. Please include a population density evaluation to support the selection of rural dispersion coefficients.

Section 5.6 Startups/Shutdowns (Keasbey Energy Center) & Table 5-1

11. In the Keasbey's March 2017 protocol, three rapid response startup scenarios were proposed for cold startups (10 times), warm startups (52 times) and hot startups (200 times) with emission rates and stack parameters provided for each startup type (Table 5-1). The current revised protocol only provided information for one rapid response startup scenario (262 times, Table 5-1). Please clarify these differences and outline the number and type of startups and shutdowns for each of the combustion turbines where applicable.

12. Section 5.6.2: In the following sentence, "As such, the 1-hour NO2 modeling analysis will not include an operating scenario with simultaneous operation of the two (2) combustion…" Did the applicant mean to say, "simultaneous **startup** operation"?

13. Section 5.6.2: In the following sentence, "This operating scenario can be included in the operating permit with a permit condition as shown below that indicates that the Woodbridge Energy Center startup scenario cannot occur simultaneously with Woodbridge Energy Center startup of both combustion turbines for more than 7 days per year." Please correct one of the instances of Woodbridge to say Keasbey.

Section 5.7 1-Hour NO_2 Modeling

14. Please ensure that the ozone concentration units used with PVMRM are correctly interpolated to model results in $\mu g/m^3$.

15. The air quality modeling report should include correspondence regarding the use of PVMRM, such as the CPV Keasbey request letter, dated June 21, 2017, and the Department's comment/approval letter, dated July 19, 2017. In addition, document all updates and variations from the previously approve approach.

Section 5.8 NJDEP Air Toxics Risk Analysis

16. This section stated that, for HAPs exceeding reporting thresholds, the 24-hour and annual concentrations will be modeled. However, many HAPs' short-term reference concentrations are 1-hour average based. Please model with the appropriate average time. Also, add "and unit risk factors" to the sentence "*The combined concentrations from Keasbey and Woodbridge will be evaluated against the reference concentrations found in the NJDEP Risk Technical Manual 1003 and risk screening worksheet*".

17. Add a table listing the HAPs to be modeled, including short-term and long-term average emission rates and toxicity thresholds.

<u>Section 5.12 PSD Increment Analysis</u>

18. Please specify the pollutants for the following minor source baseline dates:

Nov. 3, 1977 is for SO_2
Nov. 15, 1978 is for PM_{10}

<u>Section 5.15.4 Impacts on Class I Areas</u>

19. Since it has been close to five years since first corresponding with the Federal Land Manager (FLM) regarding this project, the BEP suggests contacting the FLM again to confirm the FLM's 2016 response.

TRC
1099 Wall St. West
Suite 250B
Lyndhurst, NJ 07071
T 201.933.5541
TRCcompanies.com

February 18, 2021

Mr. Greg John
Division of Air Quality, Bureau of Evaluation and Planning
New Jersey Department of Environmental Protection
401 E. State Street, 2nd Floor
Trenton, New Jersey 08625

Re: Technical Deficiencies: Title V Signification Modification
Woodbridge Energy Center (Keasbey Energy Center Project)
Permit Activity Number: BOP160004 / Program Interest Number: 18940
Submittal of Revised Air Quality Modeling Protocol (Revision 3)

Dear Mr. John:

TRC Environmental Corporation (TRC) is submitting the enclosed revised Air Quality Modeling Protocol (Revision 3) for the Keasbey Energy Center Project (Facility ID 18940, Permit Activity BOP160004) in response to the Department's October 29, 2020 notice of technical deficiency. As you are aware and were a participant to, the NJDEP and CPV Keasbey had a virtual meeting on November 17, 2020 to discuss the Department's expectations with regards to updating the air dispersion modeling protocol, analysis, and report.

As requested, the revised Air Quality Modeling protocol includes the necessary updates to the U.S. EPA dispersion model versions, updates to the meteorological and background monitoring concentration data, and updates to the facility emissions and design details that were provided in the single source air quality modeling analysis report (September 2017) and approved on November 20, 2017. To facilitate the Department's review of the changes incorporated in the revised Air Quality Modeling Protocol (Revision 3 – February 2021) from the approved Air Quality Modeling Protocol (Revision 2 – March 2017), the following sections have been updated. Brief descriptions of the requested updates are also provided for your consideration.

Updates to the revised Air Quality Modeling Protocol (Revision 3 – February 2021)

- Section 3.0 – Removed fuel oil combustion from the proposed GE 7HA combustion turbine operating scenarios for consistency with the approved single source air quality modeling analysis (September 2017)

- Section 3.0 – Updated the emission rates and stack parameters as provided in Tables 3-1 through 3-11 to reflect the most recent single source modeling analysis (September 2017) and pre-draft permit (February 2018)

- Section 3.5.3 – Revised the methodology for calculating impacts for secondary PM2.5 formation based on the most recent U.S. EPA methodology Modeled Emission Rates for Precursors (MERPs) guidance (April 30, 2019)

- Section 4.0 – Updated Table 4-1 (Facility Emission Rates) to reflect the most recent single source modeling analysis (September 2017) and pre-draft permit (February 2018)

- Section 5.0 – Updated references to the 2018 version of NJDEP TM1002 and references to AERMOD model version 19191

- Section 5.3 and Figure 5-3 - Updated meteorological data from Newark Liberty International Airport for the five (5) year period from 2013-2017, which was processed by NJDEP using AERMOD's meteorological processor, AERMET (version 18081) for use in the revised modeling analysis

- Section 5.5 - Removed fuel oil combustion from the proposed GE 7HA combustion turbine operating scenarios for consistency with the approved single source air quality modeling analysis (September 2017)

- Section 5.6.2 – Added a discussion regarding the evaluation of simultaneous operation of the Keasbey Energy Center and Woodbridge Energy Center combustion turbine startup operating scenarios for 1-hour NO_2

- Section 5.7.2 – Updated background monitoring concentrations for NO_2 by season and hour of day for the most recent 3-year period with acceptable data capture rates

- Section 5.7.3 – Updated hourly ozone data for years 2013-2017, concurrent with the five (5) years of meteorological data for use in the AERMOD model

- Section 5.9 – Updated references to AERMAP version 18081 for processing the receptor grid

- Section 5.10 and Table 5-3 – Updated background monitoring concentrations for the most recent 3- year period (2017-2019)

- Tables 5-1 and 5-2 - Updated the emission rates and stack parameters to reflect the most recent single source modeling analysis (September 2017) and pre-draft permit (February 2018)

If you have any questions concerning the attached air quality modeling protocol, please feel free to call me at (201) 508-6964. We look forward to receiving the Department's review comments/approval, as well as the opportunity to continue working with you on this project.

Sincerely,

TRC

Darin Ometz

Darin Ometz
Senior Air Quality Project Manager

CC: A. Urquhart, CPV (via email)
D. Owen, NJDEP (via email)

TRC

A. Khan, NJDEP (via email)
J. Leon, NJDEP (via email)
Y. Zhang, NJDEP (via email)
M. Keller, TRC (via email)

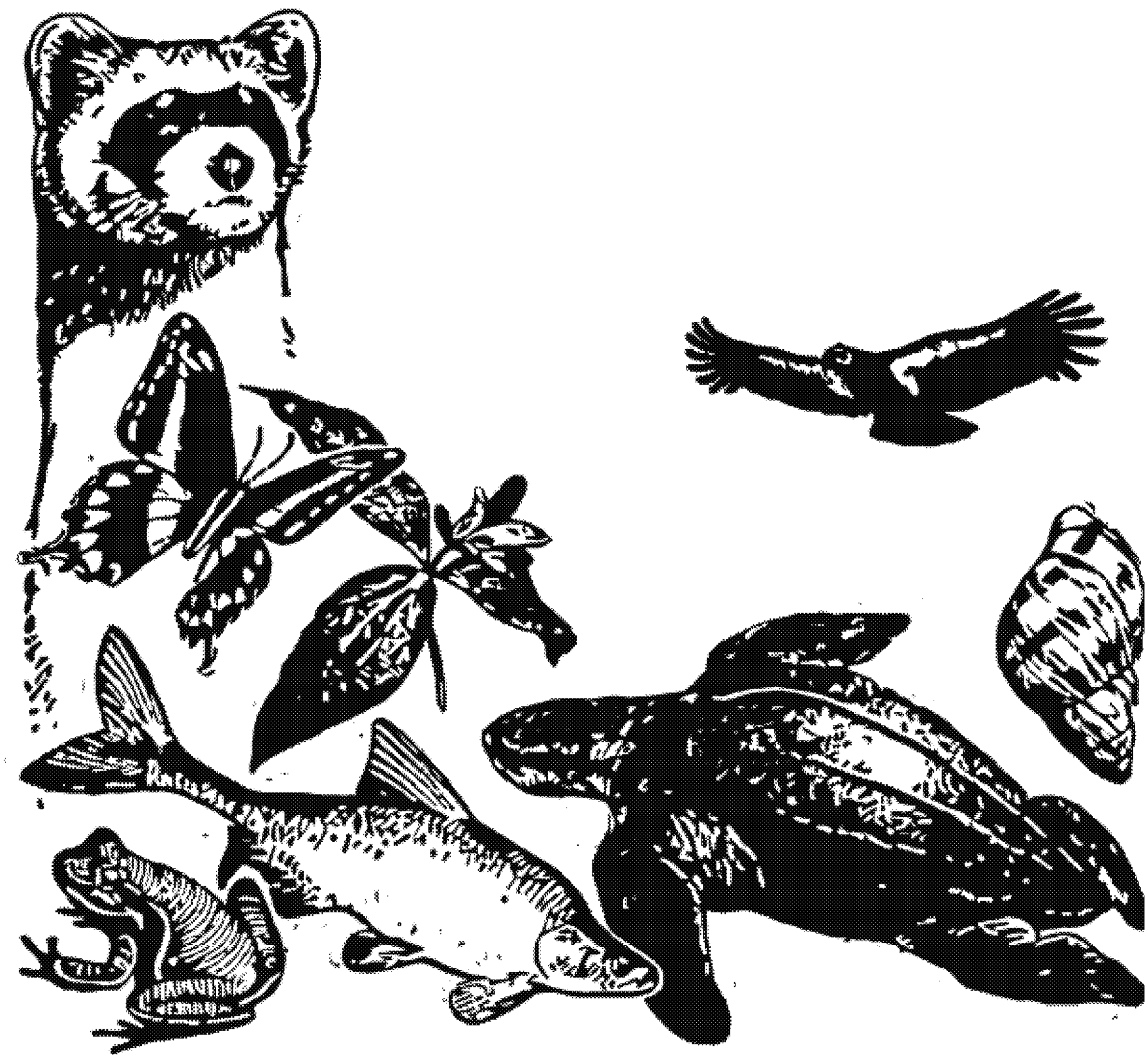
U.S. Fish & Wildlife Service

Keasbey Energy Center

IPaC Trust Resources Report

Generated July 05, 2016 11:17 AM MDT, IPaC v3.0.8

This report is for informational purposes only and should not be used for planning or analyzing project level impacts. For project reviews that require U.S. Fish & Wildlife Service review or concurrence, please return to the IPaC website and request an official species list from the Regulatory Documents page.



IPaC - Information for Planning and Conservation (https://ecos.fws.gov/ipac/): A project planning tool to help streamline the U.S. Fish & Wildlife Service environmental review process.

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Migratory Birds . . . 3
Refuges & Hatcheries . . . 6
Wetlands . . . 7

U.S. Fish & Wildlife Service

IPaC Trust Resources Report

NAME

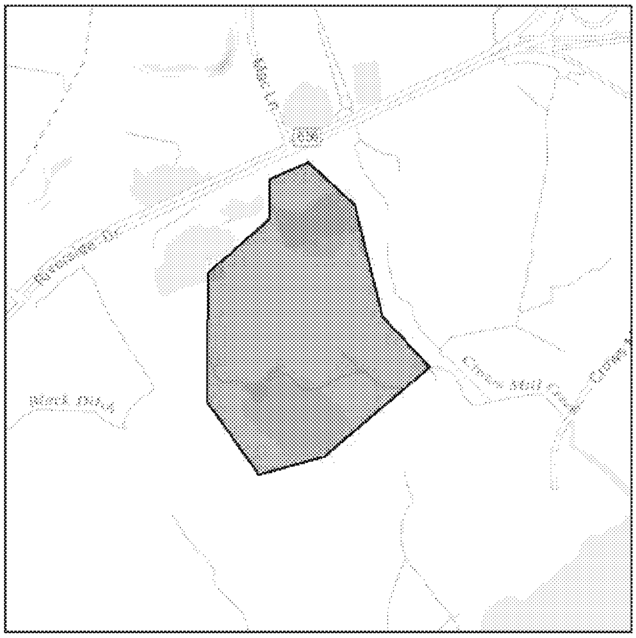
Keasbey Energy Center

LOCATION

Middlesex County, New Jersey

IPAC LINK

https://ecos.fws.gov/ipac/project/OKGMU-W3E4B-HWRMA-OGQWT-O47LWY



U.S. Fish & Wildlife Service Contact Information

Trust resources in this location are managed by:

New Jersey Ecological Services Field Office
927 North Main Street, Building D
Pleasantville, NJ 08232-1454
(609) 646-9310

Endangered Species

Proposed, candidate, threatened, and endangered species are managed by the Endangered Species Program of the U.S. Fish & Wildlife Service.

This USFWS trust resource report is for informational purposes only and should not be used for planning or analyzing project level impacts.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list from the Regulatory Documents section.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency.

A letter from the local office and a species list which fulfills this requirement can only be obtained by requesting an official species list either from the Regulatory Documents section in IPaC or from the local field office directly.

There are no endangered species in this location

Critical Habitats

There are no critical habitats in this location

Migratory Birds

Birds are protected by the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act.

Any activity that results in the take of migratory birds or eagles is prohibited unless authorized by the U.S. Fish & Wildlife Service.[1] There are no provisions for allowing the take of migratory birds that are unintentionally killed or injured.

Any person or organization who plans or conducts activities that may result in the take of migratory birds is responsible for complying with the appropriate regulations and implementing appropriate conservation measures.

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1. 50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)

Additional information can be found using the following links:

- Birds of Conservation Concern
  http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php
- Conservation measures for birds
  http://www.fws.gov/birds/management/project-assessment-tools-and-guidance/conservation-measures.php
- Year-round bird occurrence data
  http://www.birdscanada.org/birdmon/default/datasummaries.jsp

The following species of migratory birds could potentially be affected by activities in this location:

American Oystercatcher Haematopus palliatus — Bird of conservation concern
On Land Season: Year-round
http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0G8

American Bittern Botaurus lentiginosus — Bird of conservation concern
On Land Season: Breeding
http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0F3

Bald Eagle Haliaeetus leucocephalus — Bird of conservation concern
On Land Season: Year-round
http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B008

Black Skimmer Rynchops niger — Bird of conservation concern
On Land Season: Breeding
http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0EO

Black-billed Cuckoo Coccyzus erythropthalmus — Bird of conservation concern
On Land Season: Breeding
http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0HI

Blue-winged Warbler Vermivora pinus — Bird of conservation concern
On Land Season: Breeding

Canada Warbler Wilsonia canadensis — Bird of conservation concern
On Land Season: Breeding

Fox Sparrow Passerella iliaca — Bird of conservation concern
On Land Season: Wintering

Golden-winged Warbler Vermivora chrysoptera — Bird of conservation concern
On Land Season: Breeding
http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0G4

Gull-billed Tern Gelochelidon nilotica — Bird of conservation concern
On Land Season: Breeding
http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0JV

Hudsonian Godwit Limosa haemastica — Bird of conservation concern
At Sea Season: Migrating

Kentucky Warbler Oporornis formosus — Bird of conservation concern
On Land Season: Breeding

Least Bittern Ixobrychus exilis
On Land Season: Breeding
http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B092

Loggerhead Shrike Lanius ludovicianus — Bird of conservation concern
On Land Season: Year-round
http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0FY

Peregrine Falcon Falco peregrinus — Bird of conservation concern
On Land Season: Wintering
http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0FU

Pied-billed Grebe Podilymbus podiceps — Bird of conservation concern
On Land Season: Year-round

Prairie Warbler Dendroica discolor — Bird of conservation concern
On Land Season: Breeding

Purple Sandpiper Calidris maritima — Bird of conservation concern
On Land Season: Wintering

Red Knot Calidris canutus rufa — Bird of conservation concern
On Land Season: Wintering
http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0DM

Rusty Blackbird Euphagus carolinus — Bird of conservation concern
On Land Season: Wintering

Saltmarsh Sparrow Ammodramus caudacutus — Bird of conservation concern
On Land Season: Breeding

Seaside Sparrow Ammodramus maritimus — Bird of conservation concern
On Land Season: Year-round

Short-eared Owl Asio flammeus — Bird of conservation concern
On Land Season: Wintering
http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0HD

Snowy Egret Egretta thula — Bird of conservation concern
On Land Season: Breeding

Upland Sandpiper Bartramia longicauda — Bird of conservation concern
On Land Season: Breeding
http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0HC

Willow Flycatcher Empidonax traillii — Bird of conservation concern
On Land Season: Breeding
http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B0F6

Wood Thrush Hylocichla mustelina — Bird of conservation concern
On Land Season: Breeding

Worm Eating Warbler Helmitheros vermivorum — Bird of conservation concern
On Land Season: Breeding

Wildlife refuges and fish hatcheries

There are no refuges or fish hatcheries in this location

Wetlands in the National Wetlands Inventory

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

DATA LIMITATIONS

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

DATA EXCLUSIONS

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

DATA PRECAUTIONS

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

This location overlaps all or part of the following wetlands:

Estuarine And Marine Wetland

E2EM1Pd
E2EM5/1Pd

Freshwater Emergent Wetland

PEM1E
PEM5R

ED_013256A_00001458-00133

Freshwater Forested/shrub Wetland

PSS1R

Freshwater Pond

PUBHx
PUBV

Riverine

R4SBC
R5UBH

A full description for each wetland code can be found at the National Wetlands Inventory website: http://107.20.228.18/decoders/wetlands.aspx

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New Jersey Ecological Services Field Office
927 NORTH MAIN STREET, BUILDING D
PLEASANTVILLE, NJ 08232
PHONE: (609)646-9310 FAX: (609)646-0352
URL: www.fws.gov/northeast/njfieldoffice/Endangered/consultation.html

Consultation Code: 05E2NJ00-2016-SLI-0627 July 05, 2016
Event Code: 05E2NJ00-2016-E-00480
Project Name: Keasbey Energy Center

Subject: List of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed, and candidate species that may occur in your proposed action area and/or may be affected by your proposed project. This species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under Section 7(c) of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq.*)

If the enclosed list indicates that any listed species may be present in your action area, please visit the New Jersey Field Office consultation web page as the next step in evaluating potential project impacts: http://www.fws.gov/northeast/njfieldoffice/Endangered/consultation.html

On the New Jersey Field Office consultation web page you will find:

- habitat descriptions, survey protocols, and recommended best management practices for listed species;
- recommended procedures for submitting information to this office; and
- links to other Federal and State agencies, the Section 7 Consultation Handbook, the Service's wind energy guidelines, communication tower recommendations, the National Bald Eagle Management Guidelines, and other resources and recommendations for protecting wildlife resources.

The enclosed list may change as new information about listed species becomes available. As per Federal regulations at 50 CFR 402.12(e), the enclosed list is only valid for 90 days. Please return to the ECOS-IPaC website at regular intervals during project planning and implementation to obtain an updated species list. When using ECOS-IPaC, be careful about drawing the boundary of your Project Location. Remember that your action area under the ESA is not limited to just the footprint of the project. The action area also includes all areas that may be indirectly affected through impacts such as noise, visual disturbance, erosion, sedimentation, hydrologic change, chemical exposure, reduced availability or access to food resources, barriers to movement, increased human intrusions or access, and all areas affected by reasonably forseeable future that would not occur without ("but for") the project that is currently being proposed.

We appreciate your concern for threatened and endangered species. The Service encourages Federal and non-Federal project proponents to consider listed, proposed, and candidate species early in the planning process. Feel free to contact this office if you would like more information or assistance evaluating potential project impacts to federally listed species or other wildlife resources. Please include the Consultation Tracking Number in the header of this letter with any correspondence about your project.

Attachment

United States Department of Interior
Fish and Wildlife Service

Project name: Keasbey Energy Center

Official Species List

Provided by:

New Jersey Ecological Services Field Office
927 NORTH MAIN STREET, BUILDING D
PLEASANTVILLE, NJ 08232
(609) 646-9310
http://www.fws.gov/northeast/njfieldoffice/Endangered/consultation.html

Consultation Code: 05E2NJ00-2016-SLI-0627
Event Code: 05E2NJ00-2016-E-00480

Project Type: POWER GENERATION

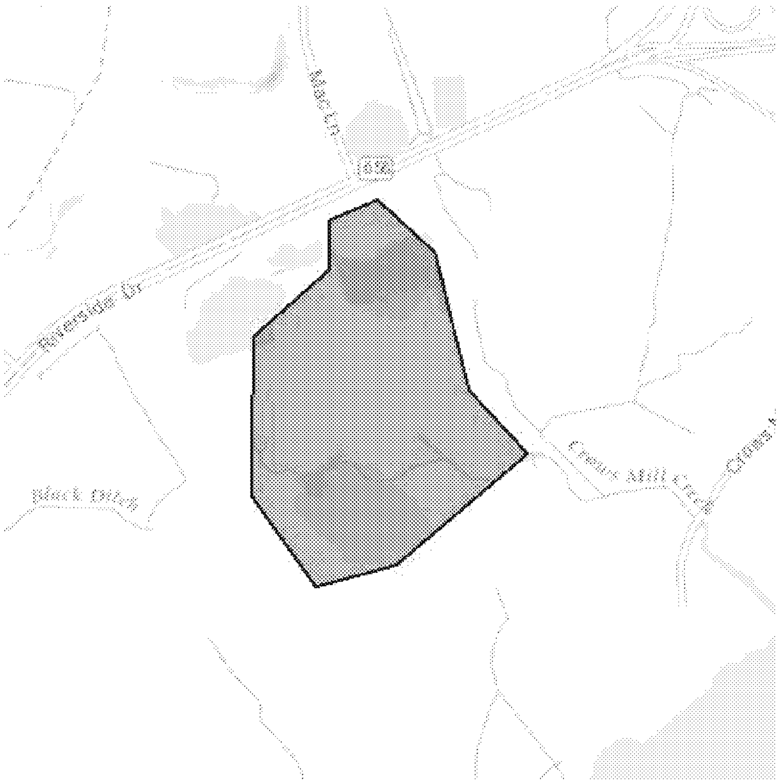
Project Name: Keasbey Energy Center
Project Description: CPV Keasbey, LLC is proposing to construct a combined cycle power facility on a parcel of land controlled by CPV that borders the existing Woodbridge Energy Center in the Township of Woodbridge, Middlesex County, New Jersey.

Please Note: The FWS office may have modified the Project Name and/or Project Description, so it may be different from what was submitted in your previous request. If the Consultation Code matches, the FWS considers this to be the same project. Contact the office in the 'Provided by' section of your previous Official Species list if you have any questions or concerns.

United States Department of Interior
Fish and Wildlife Service

Project name: Keasbey Energy Center

Project Location Map:



Project Coordinates: MULTIPOLYGON (((-74.32002067565918 40.51729008578551, -74.32117938995361 40.51693121343741, -74.32117938995361 40.516034024163, -74.3229818344116 40.51482687783199, -74.32302474975586 40.51340763745765, -74.32302474975586 40.511906798865034, -74.3215012550354 40.5102917285085, -74.3195915222168 40.51068326428807, -74.31648015975952 40.51270616273139, -74.31787490844727 40.513848094581704, -74.3186902999878 40.51634396363333, -74.32002067565918 40.51729008578551)))

Project Counties: Middlesex, NJ

Endangered Species Act Species List

There are a total of 0 threatened or endangered species on your species list. Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species. Critical habitats listed under the **Has Critical Habitat** column may or may not lie within your project area. See the **Critical habitats within your project area** section further below for critical habitat that lies within your project. Please contact the designated FWS office if you have questions.

There are no listed species identified for the vicinity of your project.

Critical habitats that lie within your project area

There are no critical habitats within your project area.

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5th Floor
Lyndhurst, NJ 07071

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www.trcsolutions.com

July 12, 2016

Mr. Greg John
New Jersey Department of Environmental Protection
Division of Air Quality, Bureau of Technical Services
401 East State Street, 2nd Floor
Trenton, New Jersey 08625

Subject: **CPV Keasbey, LLC**
Keasbey Energy Center
Proposed Combined Cycle Power Facility
Township of Woodbridge, Middlesex County, New Jersey
Request for Waiver from Pre-Construction Ambient Air Quality Monitoring

Dear Mr. John:

This letter serves as a request on behalf of CPV Keasbey, LLC (CPV Keasbey) to the New Jersey Department of Environmental Protection ("NJDEP") for a waiver from the requirement to perform one year of pre-application ambient air quality monitoring for the proposed combined cycle power facility (to be known as the Keasbey Energy Center) to be located in the Township of Woodbridge, Middlesex County, New Jersey (see Figure 1) in accordance with Prevention of Significant Deterioration (PSD) of Air Quality regulations.

These regulations state that major new or modified facilities having annual emissions of regulated air contaminants in excess of significant emission rates (SER) must provide an analysis of air quality data in the area of the proposed facility that, in general, consist of continuous air quality monitoring data gathered over a year preceding receipt of the application. As fully described below, this request is for a waiver from the pre-application ambient monitoring data requirement for the air contaminants: carbon monoxide (CO), nitrogen dioxide (NO_2), particulate matter with an aerodynamic diameter less than 10 micrometers (μm) (PM-10), and less than 2.5 micrometers (PM-2.5).

Pursuant to the PSD regulations codified in 40 CFR 51.166 and 40 CFR 52.21, U.S. EPA may exempt a proposed PSD source, otherwise subject to the one-year pre-construction ambient monitoring requirement, if either:

(1) representative existing ambient air monitoring data exists in the affected area and is of the quality and nature which demonstrates the current conditions of the area's air quality; or

(2) representative ambient air monitoring data exists from a prior time period which can be demonstrated to be conservative (i.e., higher) in establishing the current conditions of the area's air quality.

See also, 40 CFR 52.21.1670 (approved Part 231 at 75 Fed. Reg. 70, 140 (Nov. 17, 2010)) ("applicant makes an acceptable showing that representative existing ambient monitoring data exists in the affected area of the quality and nature which demonstrates the current conditions of the air quality of the area"); New Source Review Workshop Manual (Draft, October 1990) at C.18 ("To be acceptable, such data must be judged by the permitting agency to be representative of the air quality for the area in which the proposed project would be constructed and operated"). As shown below, representative data satisfying these requirements exists.

CPV Keasbey is also requesting an exemption from the pre-application ambient monitoring requirement for lead (Pb) because it will be emitted in amounts less than its SER; for fluorides, hydrogen sulfide, total reduced sulfur, and reduced sulfur compounds because they are not anticipated as a product of natural gas combustion (i.e., from the combustion turbine and auxiliary boiler) and fuel oil combustion (i.e., from the combustion turbine, emergency diesel generator, and emergency diesel fire pump); and for sulfuric acid (H_2SO_4) mist because there is no approved monitoring technique available.

Project Description

CPV Keasbey, LLC is proposing to construct a nominal 630-megawatt (MW) 1-on-1 combined cycle power facility (to be known as the Keasbey Energy Center) on a parcel of land in the Township of Woodbridge, Middlesex County, New Jersey. The combustion turbine will be primarily fueled by natural gas but will be capable of firing ultra-low sulfur diesel (ULSD) for up to 720 hours per year.

The Keasbey Energy Center will consist of one (1) General Electric (GE) 7HA.02 combustion turbine at the proposed facility site. Hot exhaust gases from the combustion turbine will flow into one (1) heat recovery steam generator (HRSG). The HRSG will produce steam to be used in the steam turbine and will be equipped with a natural gas fired duct burner. Upon leaving the HRSG, the turbine exhaust gases will be directed to one (1) exhaust stack. Other ancillary equipment at the proposed facility will include one (1) gas fired auxiliary boiler, one (1) emergency diesel fire pump, one (1) emergency diesel generator, and a wet mechanical draft cooling tower.

Emissions from the combined cycle unit will be controlled by the use of dry low-NO_x burner technology (during natural gas firing), water injection (during ULSD firing), and selective catalytic reduction (SCR) for NO_x control, an oxidation catalyst for CO and volatile organic compounds (VOCs) control, and the use of clean low-sulfur fuels (i.e., natural gas and ULSD) to minimize emissions of SO_2, PM/PM-10/PM-2.5, and H_2SO_4. Exhaust gases from the combined cycle unit after emission controls will be dispersed to the atmosphere via one (1) stack. Steam from the steam turbine will be sent to a condenser where it will be cooled to a liquid state and returned to the HRSG. Waste heat from the condenser will be dissipated through a wet mechanical draft cooling tower.

Facility Emissions

The proposed facility (as a significant modification to a major source) is located in an attainment area for SO_2, NO_2, CO, PM-10, and PM-2.5. The proposed facility will potentially emit more than the SERs for several air pollutants, and will be subject to PSD permitting for these constituents. Under PSD regulations, an air quality dispersion modeling analysis is required to ensure that CO, PM-10, PM-2.5, SO_2, and NO_2 emissions from the proposed facility will be compliant with NAAQS and applicable PSD Class II increments.

Table 1 presents projected facility emission rates and the pollutant specific significant emission rates (SERs) defined in the PSD regulations. The proposed facility is projected to have annual emissions in excess of PSD SERs for CO, NO_2, particulates (PM/PM-10/PM-2.5), and H_2SO4. The emissions of SO_2 and lead are below their SERs.

Existing Background Ambient Air Quality Data

Based on a review of the locations of NJDEP ambient air quality monitoring sites, the closest "regional" NJDEP monitoring sites will be used to represent the current background air quality in the site area.

Background data for CO was obtained from a New Jersey monitoring station located in Union County (EPA AIRData #34-039-0004). The monitor is located at Interchange 13 on the New Jersey Turnpike (Elizabeth Lab), approximately 17 km northeast of the proposed facility. This monitor is located in an area with a greater amount of mobile and point sources of air emissions as compared to the project area. Thus, this monitor would be considered to conservatively represent the ambient air quality within the project area.

Background data for PM-10 was obtained from a Jersey City monitoring station located in Hudson County, New Jersey (EPA AIRData # 34-017-1003), approximately 32 km northeast of the proposed facility. The monitor is located at 355 Newark Avenue in a commercial/urban area. This monitor is located in an area with a greater amount of mobile and point sources of air emissions as compared to the project area. Thus, this monitor would be considered to conservatively represent the ambient air quality within the project area.

Background data for NO_2 was obtained from an East Brunswick monitoring station located in Middlesex County, New Jersey (EPA AIRData # 34-023-0011), approximately 11 km west-southwest of the proposed facility. The monitor is located at Rutgers University (Veg. Research Farm #3 on Ryders Lane) in an agricultural/rural area with proximate commercial uses (i.e., Route 1 and Interstate 95). This monitor's close proximity to the Project site would qualify it to be representative of the ambient air quality within the project area.

Background data for PM-2.5 was obtained from a New Brunswick Township monitoring station located in Middlesex County, New Jersey (EPA AIRData # 34-023-0006), approximately 10 km west-southwest of the proposed facility. The monitor is located at Rutgers University's Cook College (Log Cabin Road) in an agricultural/rural area with proximate commercial uses. This monitor's close proximity would qualify it to be representative of the ambient air quality within the project area.

The monitoring data for the most recent three years (2013-2015) are presented in Table 2 while Figure 2 displays the locations of the aforementioned air quality monitors in relation to the proposed facility.

Monitoring Waiver Request

In summary, CPV Keasbey, LLC is requesting a waiver from the requirement to perform pre-application ambient air quality monitoring for CO, NO_2, PM-10, and PM-2.5 because there exists acceptable quality assured ambient air quality data from alternate locations that satisfy the requirements of 40 CFR 52.21.1670. Further, CPV Keasbey is requesting an exemption from the requirement to perform pre-application ambient monitoring for SO_2 and lead because they will be emitted in amounts less than their SERs; for fluorides, hydrogen sulfide, total reduced sulfur, and reduced sulfur compounds because they are not anticipated as a product of natural gas combustion (i.e., from the combustion turbine, and auxiliary boiler) and fuel oil combustion (i.e., from the combustion turbine, emergency diesel generator, and emergency diesel fire pump); and for H_2SO_4 because there is no approved monitoring technique available.

Please feel free to contact me (201) 508-6960 or tmain@trcsolutions.com should you have any questions regarding this monitoring exemption request.

Sincerely,

TRC

Theodore Main

Theodore Main
Principal Consulting Meteorologist

cc: A. Colecchia, U.S. EPA Region II
J. Donovan, CPV
A. Urquhart, CPV
M. Keller, TRC
TRC Project File 252973

TRC Results you can rely on

Table 1
Comparison of Projected Facility Emissions to PSD Significant Emission Rates

Pollutant	Projected Emission Rate (tons per year)	Significant Emission Rate (tons per year)
Carbon Monoxide	110.0	100
Sulfur Dioxide	39.3	40
Particulate Matter (PM)	77.6	25
Particulate Matter less than 10 microns (PM-10)	123.6	15
Particulate Matter less than 2.5 microns (PM-2.5)	119.3	10
Nitrogen Oxides	148.9	40
Lead	0.03	0.6
Fluorides	[a]	3
Sulfuric Acid Mist[b]	25.1	7
Hydrogen Sulfide	[a]	10
Total Reduced Sulfur (including H_2S)	[a]	10
Reduced Sulfur Compounds (including H_2S)	[a]	10

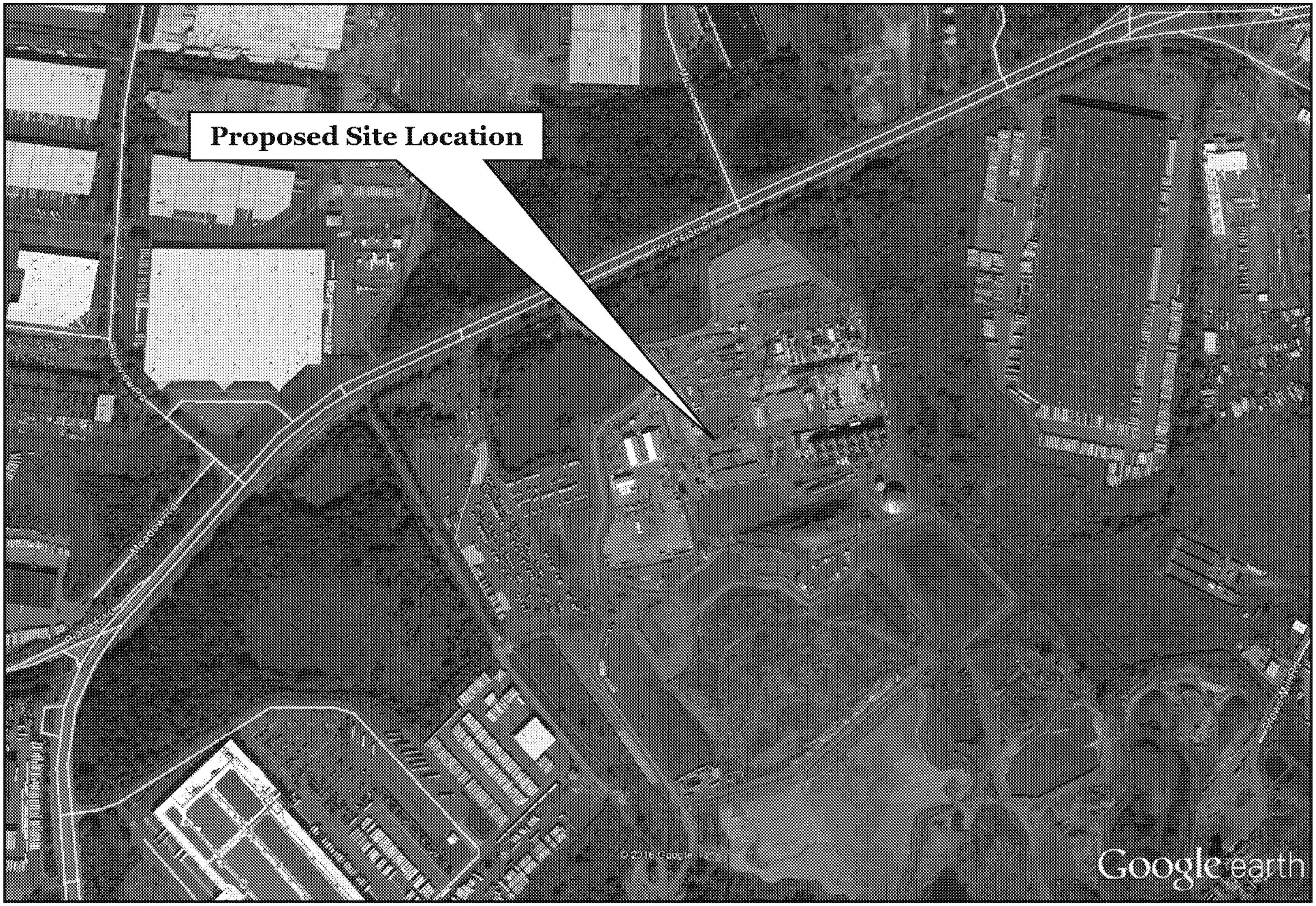
[a]Not anticipated as a product of natural gas (i.e., from the combustion turbine and auxiliary boiler) or fuel oil combustion (i.e., from the combustion turbine, emergency diesel generator, and emergency diesel fire pump), and assumed zero.

[b]No acceptable monitoring techniques exist for this pollutant.

Table 2
Ambient Concentrations of Criteria Pollutants
Proposed to be Used to Represent Site Conditions

Pollutant	Averaging Period	Maximum Ambient Concentrations (µg/m³)		
		2013	2014	2015
NO_2	1-Hour[a]	75.2	88.4	90.2
	Annual	18.8	16.9	19.3
CO	1-Hour	2,300	2,530	2,760
	8-Hour	1,495	2,070	1,840
PM-10	24-Hour	43	37	44
PM-2.5[b]	24-Hour	19.1	20	20
	Annual	8.0	8.2	7.9

[a]1-hour 3-year average 98th percentile value for NO_2 is **84.6** ug/m³.
[b]24-hour 3-year average 98th percentile value for PM-2.5 is **19.7** ug/m³; Annual 3-year average value for PM-2.5 is **8.0** ug/m³.
High second-high short term (1-, 8-, and 24-hour) and maximum annual average concentrations presented for all pollutants other than PM-2.5 and 1-hour NO_2.
Monitored background concentrations obtained from the U.S. EPA AIRData, AirExplorer and Air Quality System (AQS) websites.



Keasbey Energy Center
Proposed Combined Cycle Power Facility
Township of Woodbridge, Middlesex County, New Jersey

Figure 1. Site Location Aerial Photograph

Source: Google Earth, 2016.

TRC

Keasbey Energy Center
Proposed Combined Cycle Power Facility
Township of Woodbridge, Middlesex County, New Jersey

Figure 2. Background Ambient Air Quality Monitors

Source: Google Earth, 2016.

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July 12, 2016

Ms. Jill Webster
Environmental Scientist
United States Department of the Interior
U.S. Fish & Wildlife Service
National Wildlife Refuge System
7333 W. Jefferson Ave., Suite 375
Lakewood, Colorado 80235-2017

Subject: **CPV Keasbey, LLC**
Keasbey Energy Center
Proposed Combined Cycle Power Facility
Township of Woodbridge, Middlesex County, New Jersey
Need for Class I Area Air Quality and Air Quality Related Values (AQRV) Analyses for the Brigantine Wilderness Class I Area

Dear Ms. Webster:

TRC has been retained by CPV Keasbey, LLC (CPV Keasbey) to prepare a Prevention of Significant Deterioration (PSD) permit application for a proposed nominal 630-megawatt (MW) combined cycle power facility (to be known as the Keasbey Energy Center) to be constructed in the Township of Woodbridge, Middlesex County, New Jersey. The approximate Universal Transverse Mercator (UTM) coordinates of the Keasbey Energy Center are 557,517 meters Easting, 4,485,098 meters Northing, in Zone 18, NAD83.

The Keasbey Energy Center project design reflects the planned installation of one (1) General Electric (GE) 7HA.02 combustion turbine at the facility. The combustion turbine will be primarily natural gas-fired but will be capable of utilizing ultra-low sulfur diesel (ULSD) for up to 720 hours per year. Dry low NO_x burners (during natural gas firing), water injection (during ULSD firing), and Selective Catalytic Reduction (SCR) will be used to reduce nitrogen oxides (NO_x) emissions from the combustion turbine. The firing of natural gas and ULSD will minimize emissions of particulate matter with an aerodynamic diameter less than 10 microns (PM-10), sulfur dioxide (SO_2) and sulfuric acid mist (H_2SO_4). Additionally, an oxidation catalyst will be installed to control the emissions of carbon monoxide (CO) and volatile organic compounds (VOC).

Exhaust gases from the combustion turbine will flow into an adjacent heat recovery steam generator (HRSG). The HRSG will produce steam to be used in the steam turbine generator and will be equipped with a natural gas fired duct burner. Combustion products will be discharged through one (1) exhaust stack. Supporting auxiliary equipment includes a gas fired auxiliary boiler, one (1) emergency diesel generator, one (1) emergency diesel fire pump, and a wet mechanical draft cooling tower.

Estimated potential short-term (24-hour) maximum emissions and annual emissions are presented in Table 1. The PM-10 emission rates presented in Table 1 include filterable and condensable particulates.

Table 1: Estimated Potential Emissions

Pollutant	Combustion Turbine Maximum Short-Term Emissions (lb/hr)		Annual Emissions[1] (tpy)	Annual Emissions[2] (tpy)
	Natural Gas Fired	ULSD Fired		
Nitrogen Oxides (NO_x)	32.8	56.1	152.1	246
Sulfur Dioxide (SO_2)	9.6	6.6	41.0	29
Particulate Matter with an aerodynamic diameter less than 10 microns (PM-10)	23.4	64.6	117.3	283
Sulfuric Acid Mist (H_2SO_4)	6.1	4.3	26.1	19

[1]Annual emissions based on one (1) GE 7HA.02 combustion turbine operating 8,040 hours per year on natural gas and 720 hours per year on ULSD at the respective maximum short-term emission rates.
[2]Annual emissions based on one (1) GE 7HA.02 combustion turbine hypothetically operating 8,760 hours per year on ULSD at the ULSD short-term emission rate (solely for comparison to FLAG Q/D guidance, and not for permitting).

The Brigantine Wilderness Class I area located in the Edwin B. Forsythe National Wildlife Refuge in New Jersey is approximately 108 km south of the proposed facility. Following the Draft Revised FLAG guidance (2010), TRC believes that the proposed facility may be eligible for an exemption from the requirement to perform a Class I area modeling analysis because of its inherent low emissions and distance to the Class I area. We understand that the maximum short-term emission rates are used in the exemption analysis. Assuming full year operation (8,760 hours) of the combined cycle combustion turbine (firing ULSD) yields a (emission in tpy)/(distance in km) ratio (577 tons per year/108 km) of approximately 5.3. It should be noted that this assumption is conservative since the combustion turbine will be capable of firing ULSD for up to 720 hours per year. It is our understanding that according to the Q/D test, the FLM should consider this source (which is located greater than 50 km from the Brigantine Wilderness Class I area) and has a ratio of annual equivalent emissions (Q in tons per year) divided by distance (D in km) from the Brigantine Wilderness Class I area (km) < 10, as having negligible impacts with respect to Class I visibility impacts and that there would not be any Class I visibility impact analyses required from this source.

With this letter, TRC, on behalf of CPV Keasbey, LLC, is formally requesting a determination that there is no need to perform a Class I area air quality and AQRV analysis for the Brigantine Wilderness Area as part of the facility's PSD Air Permit application. If you should require additional information on the proposed Project or have any questions, please feel free to contact me at (201) 508-6960 or tmain@trcsolutions.com.

Sincerely,

TRC

Theodore Main
Principal Consulting Meteorologist

cc: J. Donovan, CPV
A. Urquhart, CPV
M. Keller, TRC
TRC Project File 252973

Keller, Michael

From: Webster, Jill <jill_webster@fws.gov>
Sent: Wednesday, July 13, 2016 11:09 AM
To: Keller, Michael
Subject: Re: CPV Keasbey, LLC - Need for Class I AQ Analyses for Brigantine Wilderness Area

Mr. Keller,

Thank you for sending the information regarding CPV Keasbey, LLC located in Middlesex County, New Jersey. Based on the information contained in the letter dated July 12, 2016, the Fish and Wildlife Service anticipates that modeling would not show any significant additional impacts to air quality related values (AQRV) a the Brigantine Wilderness. Therefore, we are not requesting that a Class I analysis be included in the PSD permit application.

The state and/or EPA may have a different opinion regarding the need for a Class I increment analysis. Should the emissions or the nature of the project change significantly, please contact me directly so that we might re-evaluate the proposed project.

Thank you for keeping us informed and involving the Fish and Wildlife Service in the project review.

On Wed, Jul 13, 2016 at 5:43 AM, Keller, Michael <MKeller@trcsolutions.com> wrote:

> Ms. Webster,
>
> TRC, on behalf of CPV Keasbey, LLC, is formally requesting a determination (see attachment) that there is no need to perform a Class I area air quality and air quality related values analysis for the Brigantine Wilderness Class I area as part of the facility's PSD permit application.
>
> If you have any questions, please call or email.
>
> Thanks for your attention.
>
> Michael
>
> Michael D. Keller
> Senior Project Manager

1200 Wall Street West, 5th Floor, Lyndhurst, NJ 07071

T: 201.508.6954 | F: 201.933.5601 | MKeller@trcsolutions.com

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 2
290 BROADWAY
NEW YORK, NY 10007-1866

JUL 26 2016

Theodore Main
Principal Consulting Meteorologist
TRC Consulting
1200 Wall Street West
Lyndhurst, New Jersey 07071

Re: Preconstruction Ambient Air Monitoring Waiver Request for the Keasbey Energy Center in Woodbridge, New Jersey.

Dear Mr. Main:

The U.S. Environmental Protection Agency reviewed the July 12, 2016 request for a preconstruction ambient air monitoring waiver for the proposed modification at the Keasbey Energy Center in Woodbridge, New Jersey. According to the proposal, the proposed modification project will be PSD effected for CO, NOx, PM10 and PM2.5. Should the emission estimates be revised, (e.g., the net emission increase of S02 are currently estimated to be 39.3 tons per year) then the monitoring waiver request will need to be re-evaluated.

We preliminarily agree that the project may be exempt from installing ambient air monitors since ambient air data already exists that may be used for this purpose. Depending on the pollutant, the existing data is either representative or conservative, and provides 3 years of current information. However, it is not noted whether the data was QA/QC'ed. This should be part of the request. Please verify that the data was QA/QC'ed such that we may provide final approval for the waiver.

Meanwhile, we noted the some language in the request that should be corrected. This includes the following:

- There are some incorrect citations to the regulations and mixes in regulatory text from the New York State regulations. These are akin to typos that should be corrected. For example: 40 CFR 52.21.1670 (approved Part 231 at 75 Fed. Reg. 70, 140 (Nov. 17, 2010) should simply be 40 CFR part 52.21.

- New Jersey implements the PSD program under delegated federal rules found in 40 CFR part 52.21. The reference to 40 CFR 51. 166 should be removed since this applies to States that implement the PSD program under their own SIP approved State rules.

- While we agree in part with the rational regarding certain criteria that may be used to exempt a source from preconstruction ambient monitoring requirements, the some language in the request is not actually in the regulatory text cited. In addition, it is not clear where the (2) bullet is found. Please correct these references. In particular, we are referring to the following excerpt:

"*Pursuant to the PSD regulations codified in 40 CFR 51.166 and 40 CFR 52.21, U.S. EPA may exempt a proposed PSD source, otherwise subject to the one-year pre-construction ambient monitoring requirement, if either:*

(1) representative existing ambient air monitoring data exists in the affected area and is of the quality and nature which demonstrates the current conditions of the area's air quality; or
(2) representative ambient air monitoring data exists from a prior time period which can be demonstrated to be conservative (i.e., higher) in establishing the current conditions of the area's air quality."

If you have any questions regarding this letter you may contact Annamaria Colecchia of my staff at (212) 637-4016.

Sincerely,

Steven C. Riva, Chief
Permitting Section, APB

cc: Greg John, NJDEP

CHRIS CHRISTIE
Governor

KIM GUADAGNO
Lt. Governor

DEPARTMENT OF ENVIRONMENTAL PROTECTION
AIR QUALITY, ENERGY AND SUSTAINABILITY
DIVISION OF AIR QUALITY
P.O. Box 420 Mailcode 401-02
TRENTON, NJ 08625-0420
609 - 984 - 1484

BOB MARTIN
Commissioner

MEMORANDUM

TO: Aliya Khan, Bureau of Stationary Sources

FROM: Jennifer Levy, Bureau of Evaluation and Planning

DATE: October 25, 2016

SUBJECT: CPV Keasbey, LLC
Air Quality Modeling Protocol (dated August 2016)
Woodbridge, Middlesex County, New Jersey
PI# 55824 BOP Application Number 160004

CPV Keasbey, LLC is proposing to construct and operate a new 630 MW combined cycle unit, identified as Keasbey Energy Center, directly adjacent to the 725 MW Woodbridge Energy Center, in Woodbridge, Middlesex County, New Jersey. The Keasbey Energy Center will consist of one dual fuel (natural gas or ultra-low sulfur diesel oil) General Electric 7HA.02 combustion turbine, one heat recovery steam generator, one natural gas-fired auxiliary boiler, one emergency diesel generator, one emergency diesel fire pump, a steam turbine generator, and a wet mechanical draft cooling tower. Control devices include dry low-NOx combustors, water injection, selective catalytic reduction (SRC), and oxidation catalyst.

The proposed project will be subject to PSD review for Greenhouse Gases(GHG), nitrogen oxides (NO_x), particulate matter less than 10 microns (PM_{10}), particulate matter less than 2.5 microns($PM_{2.5}$), carbon monoxide(CO), sulfuric acid mist (H_2SO_4), and sulfur dioxide (SO_2). The project will be subject to non- attainment new source review for NO_x and volatile organic compounds (VOC).

The Bureau of Evaluation and Planning (BEP) in collaboration with EPA Region II has completed its initial review of the above referenced document. The attached comments should be addressed in the form of a revised modeling protocol. If there are any questions regarding the attached comments, contact Jennifer Levy at (609) 633-8239.

cc:
Bachir Bouzid (BOsS)
Danny Wong (BEP)
Joel Leon (BEP)
Greg John (BEP)
Annamaria Colecchia (EPA- emailed)
Ted Main (TRC)
Michael Keller (TRC)

Bureau of Evaluation and Planning Comments on the CPV Keasbey, LLC Air Quality Modeling Protocol, Dated August, 2016

General comments

1) Pollutant emissions from both the Keasbey Energy Center and the Woodbridge Energy Center must be evaluated together and their combined impact must comply with all state and federal regulations. This is consistent with the department's policy for phased projects with less than two years of contemporaneous operation. The combined impact of both facilities operations will need to be assessed and compared to the applicable significant impact levels; this will require a major revision to the protocol.

2) CPV Keasbey needs to submit a site survey in accordance with the requirements set out in N.J.S.A. 45:8 et seq., N.J.A.C. 13:40-1.1 et seq., and the Bureau's Technical Manual 1002. The survey should clearly show the location of all emission points to be modeled, building structures, elevations at the facility, drawn to scale, not reduced, and indicating true north. This plot plan should include the Woodbridge Energy center and the Keasbey Energy Center.

3) What is the contractual limit for sulfur content in the natural gas provided by your suppliers? CPV must use the contractual maximum gas fuel sulfur content in the estimation of its sulfur derived emissions for modeling purposes unless permit limits exist to ensure that the assumed sulfur content is not exceeded by the actual sulfur content. If limits exist, provide a brief overview of them in the protocol. If they do not exist, revise the SO_2 emission rate along with any other pollutant emissions that would be impacted by the sulfur content.

4) Add a section to the protocol detailing how the $PM_{2.5}$ increment analysis for both Class I and II will be performed. The $PM_{2.5}$ SIL is no longer used to avoid a cumulative analysis of the increment except for the cases outlined in the guidance memorandum from *U.S. Environmental Protection Agency Guidance for $PM_{2.5}$ Permit Modeling*, May 20, 2014 and in the August 18, 2016 EPA draft guidance memorandum. Include a discussion which addresses this guidance and how this will affect the CPV Keasbey PSD permit application.

Section 1.0 Introduction

5) Page 1-1 states that the source is PSD affected for ozone (VOC). The area is nonattainment for ozone, thus subject to the nonattainment regulations with regard to ozone.

Section 3.1 Equipment/Fuels

6) List and detail the equipment from Woodbridge Energy Center that will be included in the air dispersion modeling demonstration.

Section 3.2 Operation

7) Provide details on the worst-case operating scenarios that will modeled for Keasbey Energy Center, the operating scenarios that were evaluated for Woodbridge Energy Center, and the worst-case operating scenarios from each of the power plants that may operate concurrently.

Section 3.3 Selection of Sources for Modeling

8) Calculations in Appendix B of the Keasbey Energy Center Combined Cycle Power Facility PSD Air Permit Application show that PM-10 emissions from the Keasbey Energy Center cooling tower will be greater than 1 lb/hr. The Department's Technical Manual 1002: Guideline on Air Quality Impact Modeling Analysis guidance states that cooling towers must be included in the air quality modeling when their PM-10 emissions exceed 1 lb/hr. Thus, it appears the PM-10 and PM-2.5 cooling tower emissions from both the Keasbey and Woodbridge power plants should be modeled.

9) Details on how the particulate emission rates are calculated and what assumptions are made for the cooling tower emissions, including vendor specifications, must be included in the modeling protocol and analysis. A professional journal from AWMA in 2002 is referenced as the source used to calculate the PM10/PM2.5 emissions from the cooling towers. The applicant should provide more updated literature search and also provide rational for not using AP42 emission factors. Confirm whether evaporative condensable emissions are considered from these units.

10) Please clarify the discrepancy between pages 3-2 and 3-5 regarding the modeling of the emergency generator and fire pump. To be clear, these units are not automatically exempt from modeling. Furthermore, the exemption given in the referenced EPA March 11, 2011 memo is only for the probabilistic 1-hour average NAAQS only. For example, it is not for carbon monoxide since carbon monoxide is not a probabilistic standard. It is also not for PM2.5 since this is a daily average. The reason some exemptions may be considered by the reviewing agencies is that the occurrence of that emission scenario is so infrequent and short duration that the likelihood of it occurring during the hour of the worst case meteorology is low. Therefore, it is not likely that the sporadic occurrence of that exempt emission scenario would lead to an exceedance of the NAAQS. In addition, the fact that it would be modeled as a continuous emission scenario for 8760 hours per year may be overly conservative. It was not clear that the applicant intended to show this low probability in the protocol. The same EPA March 11, 2011 guidance did not provide a blanket exemption, especially to testing and maintenance of these emergency equipment

where this activity may be scheduled and is routine. In this case the testing and maintenance proposed for 100 hours per year should still be examined further before granting the exemption. EPA also understands that NJDEP has developed guidance in this respect but provides this guidance in addition to the NJDEP guidance.

Section 3.4 Exhaust Stack Configuration and Emission Parameters

11) Provide explanation and units for the 2.06 value used in the SO_2 calculations and 0.8 and 1.74 values used in the NO_x calculations.

12) Move Woodbridge Energy Center Source parameter tables forward from Appendix B.

Section 3.5 GEP Analysis

13) Provide a table identifying all buildings on and off site with the potential to cause aerodynamic downwash of emissions from the stack. This analysis need only consider buildings within 0.8 kilometer or 5 L from the stack, whichever is lesser. For each stack, a table shall be provided with the following data for each building (or tier):

    a. Building height (relative to stack base elevation);
    b. Maximum projected building width;
    c. Distance from the stack;
    d. 5L distance; and
    e. Calculated formula GEP stack height.

Tables 3-1a and 3-1b

14) Will the facility operate in simple cycle mode?

15) The text suggest that these tables are the combined parameters for the combustion turbine and the HRSG. If that is correct, please modify the table name to reflect this.

16) Define the stack height in the footnote.

Table 3-3

17) Please add location coordinates and an elevation to the table for consistency.

18) Provide cooling tower parameters for Woodbridge Energy Center. See comment 12.

4.1.2 Prevention of Significant Deterioration

19) The text states that if the modeled concentrations are less than the SILs, then NAAQS and increments analyses are not required. Due to a court decision in 2013, this is not a blanket conclusion. More recent EPA guidance, such as the May 2014 PM2.5 guidance is recommended for other pollutants as well. It states that the applicant and reviewing agencies examine existing conditions to ensure that a NAAQS or increment could not be

exceeded even with de minimis impacts. Even recent draft guidance for O3/PM2.5 SILs reiterates that SILs are discretionary especially in areas with significant growth (August 18, 2016). The increment will need to be evaluated.

20) The interim SIL value of 10.0 ug/m^3 for the 1 hour NO_2 may be used for the initial impact analysis. However, should a violation be found, the proposed EPA SIL of 7.5 ug/m^3 should be used for the NAAQS analysis. The text needs clarification explaining where the interim value comes from and justification for the value (see "NESCAUM Recommendations on the Use of an Interim Significant Impact Level (SIL) in Modeling the 1-Hour NO2 NAAQS", Northeastern States for Coordinated Air Use Management, April 21, 2010). Please include this document in Appendix A.

21) Include both the Class I and II SILs and PSD Increments in the discussion.

22) The text states that NJDEP administers the PSD program under 40 CFR 51.166 and they received delegation in February 22, 1983. This should be corrected. NJDEP administers the PSD program under the federal rules of 40 CFR 52.21. The delegation agreement was updated on July 15, 2011.

4.1.3 Preconstruction Ambient Air Quality Monitoring Exemption

23) While not part of this modeling protocol, a response to EPA's July 26, 2016 comments on the preconstruction ambient monitoring waiver request remains outstanding. In addition, the request should be revised to include pertinent information regarding the Woodbridge power plant.

Table 4-1

24) Remove preliminary from the column name. Please be aware that should facility emission rates change, air dispersion modeling may have to be redone.

25) Include a column showing the emissions from just the Keasbey Energy Center and a column showing the total emissions when combining the Keasbey and Woodbridge power plant emissions.

26) Clarify in a footnote or the table title whether the emission rates presented refer to all equipment or a subset of the equipment.

Table 4-2

27) Please add Class I SIL and PSD values to this table.

28) BEP would prefer that the information in footnote a be presented in a separate table showing how the modeling results will be used to calculate the value for each pollutant and applicable averaging time to show compliance with NAAQS, SILs and NJAAQS. Please include information about the annual averaging times and about the lead assessment.

29) Typo in footnote "a": The 24-hour PM2.5 NAAQS is a 3 year average of the 98th percentile. The word "average" should be included (similar to the 1 hour NO2 or SO2.)

30) Footnote "b" should reference the NESCAUM recommendation. See "NESCAUM Recommendations on the Use of an Interim Significant Impact Level (SIL) in Modeling the 1-Hour NO2 NAAQS"; Northeastern States for Coordinated Air Use Management; April 21,2010. Include this document in appendix A.

Section 5.2 Surrounding Area and Land Use

31) BEP agrees that the rural land use option can be used. As discussed in the Air Quality Permitting Program's Technical Manual 1002 Section 6.4.1, the land use analysis should be based on the Auer Land Use Classification method using the latest available USGS topographic maps, the percentage of each land use type, and the total percentages of urban versus rural landscape should be provided.

Section 5.3 Meteorological Data

32) Provide a better justification for why Brookhaven upper air was chosen for the study. For example, "the next most proximate upper air station is XX ..."

Section 5.5 Load analysis

33) Add NJAAQS to the list of assessments

34) Provide details on the worst-case operating scenarios that will modeled for Keasbey Energy Center, the operating scenarios that were evaluated for Woodbridge Energy Center, and the worst-case operating scenarios from each of the power plants that may operate concurrently.

35) Please provide calculations of the exhaust velocity from Tables 3-1a and 3-1b, for the various operating loads.

Section 5.6 Startups/Shutdowns

36) Modeling analysis for the startup and shutdown conditions will need to evaluate emissions of all criteria pollutants with short-term NAAQS and all startup types (warm, hot, cold) for natural gas operations. Startup numbers should be based on combined operation of both power plants.

37) Will there be concurrent startups for both power plants? If so, please detail how the scenario(s) will be modeled. Emissions will need to include operations at the Woodbridge Energy Center and all operating scenarios listed in the Keasbey Permit application.

38) It is stated that the scenario will be modeled if the pollutant(s) has a higher emissions during startup and shutdown conditions when compared to normal operation. This is not acceptable since the impacts may be higher given the reduced stack flow and stack temperature. These impacts must be assessed.

39) Startup under ULSD are not proposed since they are limited to 10-20 (two power plants) of these startups per year and the applicant claims these could be considered transient. Perhaps this may be true for the probabilistic 1 hour NO_2 or 1 hour SO_2 NAAQS demonstrations but this is not true for the CO NAAQS since they are based on a different statistic.

40) Please clarify further what is meant on page 5-5, "Since SO2 emissions are strictly dependent upon fuel flow (and lower during startup than continuous operation), SO2 startups are not proposed to be evaluated."

Section 5.7 1-hour NO2 Modeling

41) It is unclear if the emergency diesel generator and emergency diesel fire pump are the only pieces of equipment CPV is proposing be exempt from the 1 hour NO_2 modeling requirement. Provide clarification. Additionally, include a reference to the NJDEP policy memorandum used to justify exemption from modeling requirements. Ensure that the proposal to not include the fire pump and emergency generator conforms to the Departments' policy memorandum dated July 2011 *Exempting Emergency Generator and Fire Pump Nitrogen Oxide(NO2) and Sulfur Dioxide (SO2) Emissions from 1-hour NO2 and SO2 Air Quality Modeling.* Provide information in the protocol about whether all conditions in the above referenced memo are met by permit conditions.

42) Include the auxiliary boiler in this section's discussion. In addition, provide details on the Woodbridge Energy Center sources that will be included in the 1-hour NO_2 NAAQS compliance demonstration.

43) The protocol should provide more information regarding how the 1 hour NO_2 modeling will be undertaken. The protocol simply states that the EPA guidance will be used including the September 30, 2014 guidance. This September guidance relates to the beta ARM2 technique which require more detail on how it will be implemented (e.g., in-stack ratios, and ambient ozone data). It is not clear if the applicant intends to use this technique or was simply listing guidance that is available. If the applicant proposes to use the beta ARM2 technique, they should send EPA Region 2 the proposal for approval. In either case, more details are needed for the 1 hour NO_2 modeling procedure.

Section 5.8 NJDEP Air Toxics Risk Analysis

44) Include all of the sources at the Keasbey and Woodbridge Energy Centers, including tanks, for comparison to air toxic substance unit risk factors and reference concentrations. The bureau recommends the use of AERMOD for a risk assessment rather than multiple and non-concurrent evaluations of risk using the Risk Screening Worksheet.

Section 5.9 Receptor Grid

45) Discuss placing elevated receptors at the Fresh Kills Landfill on Staten Island, New York.

46) As discussed in the Air Quality Permitting Program's Technical Manual 1002 Section 9.1, fine grids of 50m should be placed over the areas of maximum concentration to ensure that the true maximum concentration is identified.

5.11 NAAQS/NJAAQS Analysis

47) Please confirm that NAAQS/NJAAQS will be evaluated by showing that the impacts plus the ambient background are less than the NAAQS/NJAAQS values for applicable averaging periods, even if the impacts are less than the SIL.

48) Since the combined emissions from both power centers for SO_2 will be above the 40 tons/yr threshold, an air dispersion modeling demonstration for the 1 hour SO2 NAAQs and SO2 increments (3 hour, 24 hour and annual average) must be included.

5.12 PSD Increment Analysis.

49) Comparison to Significant Impact Levels does not determine whether demonstrating compliance with PSD increments is required. Since this project's total emissions trigger PSD review, the modeling analysis should compare Keasbey and Woodbridge Energy Centers combined impacts to PSD Class I and Class II Increments.

5.15.2 Assessment of Impacts on Soils and Vegetation

50) BEP recommends using compliance with NJAAQS and NAAQS combined with the screening criteria for SO_2 shown in the table below as an acceptable demonstration for protection of vegetation.

Table 1. Soils and Vegetation Screening Values

Pollutant	Averaging Period	Screening Value (μg/m)[a]
SO_2	3-hour	786
	Annual	18

a) The screening value is based on the sensitive vegetation screening value in *A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals* (EPA document 450/2-81-078). This value should be compared to the maximum average ambient air concentration plus background for the specified averaging period.

5.15.3 Impact on Visibility

51) Provide a brief overview of the model, details on the methodology for running the model, and criteria that will be used to interpret the results from VISCREEN model. Visibility modeling should include emissions from the cooling towers.

5.15.4 Impacts on Class I Areas

52) It appears that the Federal Land Manager was notified of the Keasbey Energy Center without including information pertaining to the Woodbridge Energy Center. Please re-contact and notify the FLM of the combined emissions of the two power plants for their evaluation.

53)While the FLM provided a waiver to address the AQRV in Brigantine, the Class I increment must be considered since the source is only 108 km distance.

54) For comparison of Class I SILs and PSD Increments, predicted impact concentrations at receptors at distance of 50 km from the Keasbey/Woodbridge site in the radial direction of the Class I Area located at the Brigantine Edwin B. Forsythe National Wildlife Refuge will be required.

Tables 5.1 and 5.2

55) Startup event emissions and hourly emissions should not be identical as the startup emissions are proposed to be prorated to the duration of startup time.

Table 5.3

56) Add a column to the table specifying the monitoring stations used to provide ambient air concentrations.

57) The 2015 3-Hour SO_2 ambient air concentration at Elizabeth Lab is 55.0 ug/m^3. This 2015 value should be used as the background value for any NAAQS analysis.

58) In footnote b, the 1-hour 3-year average 98th percentile for NO_2 should be 84.91 ug/m^3.

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December 13, 2016

Ms. Jill Webster
Environmental Scientist
United States Department of the Interior
U.S. Fish & Wildlife Service
National Wildlife Refuge System
7333 W. Jefferson Ave., Suite 375
Lakewood, Colorado 80235-2017

Subject: CPV Keasbey, LLC
Keasbey Energy Center
Proposed Combined Cycle Power Facility
Township of Woodbridge, Middlesex County, New Jersey
(REVISED) Need for Class I Area Air Quality Related Values (AQRV) Analyses for the Brigantine Wilderness Class I Area

Dear Ms. Webster:

In response to a comment from the NJDEP regarding the request for determination that there is no need to perform a Class I AQRV analysis for the Brigantine Wilderness Class I area that was submitted to your attention on July 12, 2016 (as part of the CPV Keasbey, LLC's PSD air permit application), TRC is submitting this revised request.

CPV Keasbey, LLC is proposing to construct a nominal 630-megawatt (MW) 1-on-1 combined cycle power facility (to be known as the Keasbey Energy Center) on a parcel of land directly adjacent the existing Woodbridge Energy Center in the Township of Woodbridge, Middlesex County, New Jersey. The approximate Universal Transverse Mercator (UTM) coordinates of the Keasbey Energy Center are 557,515 meters Easting, 4,485,100 meters Northing, in Zone 18, NAD83. The Keasbey Energy Center will represent a significant modification of the Woodbridge Energy Center. The NJDEP has requested the Project send you a revised notification that includes the combined emissions of the existing Woodbridge Energy Center and the proposed Keasbey Energy Center.

The Keasbey Energy Center project design reflects the planned installation of one (1) General Electric (GE) 7HA.02 combustion turbine at the facility. The combustion turbine will be primarily natural gas-fired but will be capable of utilizing ultra-low sulfur diesel (ULSD) for up to 720 hours per year. Dry low NO_x burners (during natural gas firing), water injection (during ULSD firing), and Selective Catalytic Reduction (SCR) will be used to reduce nitrogen oxides (NO_x) emissions from the combustion turbine. The firing of natural gas and ULSD will minimize emissions of particulate matter with an aerodynamic diameter less than 10 microns (PM-10), sulfur dioxide (SO_2) and sulfuric acid mist (H_2SO_4). Additionally, an oxidation catalyst will be installed to control the emissions of carbon monoxide (CO) and volatile organic compounds (VOC).

Exhaust gases from the combustion turbine will flow into an adjacent heat recovery steam generator (HRSG). The HRSG will produce steam to be used in the steam turbine generator and will be equipped with a natural gas fired duct burner. Combustion products will be discharged through one (1) exhaust stack. Supporting auxiliary equipment includes a gas fired auxiliary boiler, one (1) emergency diesel generator, one (1) emergency diesel fire pump, and a wet mechanical draft cooling tower.

Estimated potential short-term (24-hour) maximum emissions and annual emissions for the proposed combustion turbine at the Keasbey Energy Center are presented below in Table 1. The PM-10 emission rates presented in Table 1 include filterable and condensable particulates.

Table 1: Estimated Potential Emissions (Keasbey Energy Center)

Pollutant	Combustion Turbine Maximum Short-Term Emissions (lb/hr)		Annual Emissions[1] (tpy)	Annual Emissions[2] (tpy)
	Natural Gas Fired	ULSD Fired		
Nitrogen Oxides (NO_x)	32.8	57.7	153	253
Sulfur Dioxide (SO_2)	9.6	6.8	42	30
Particulate Matter with an aerodynamic diameter less than 10 microns (PM-10)	23.6	65.0	119	285
Sulfuric Acid Mist (H_2SO_4)	6.2	4.4	27	20

[1]Annual emissions based on one (1) GE 7HA.02 combustion turbine operating 8,040 hours per year on natural gas and 720 hours per year on ULSD at the respective maximum short-term emission rates.
[2]Annual emissions based on one (1) GE 7HA.02 combustion turbine hypothetically operating 8,760 hours per year on ULSD at the ULSD short-term emission rate (solely for comparison to FLAG Q/D guidance, and not for permitting).

Similarly, the existing Woodbridge Energy Center includes two (2) General Electric (GE) 7FA.05 combustion turbines that exclusively utilize natural gas as their fuel. The combustion turbines are equipped with natural gas fired duct burners for supplementary firing and a single steam turbine generator (STG). Dry low NO_x burners and Selective Catalytic Reduction (SCR) reduce nitrogen oxides (NO_x) emissions from the combustion turbines. Additionally, an oxidation catalyst controls the emissions of carbon monoxide (CO) and volatile organic compounds (VOC).

Potential short-term (24-hour) maximum emissions and annual emissions for the two (2) existing combustion turbines at the Woodbridge Energy Center are presented below in Table 2. The PM-10 emission rates presented in Table 1 include filterable and condensable particulates.

Table 2: Potential Emissions (Woodbridge Energy Center)

Pollutant	Combustion Turbine/Duct Burner Maximum Short-Term Emissions[1] (lb/hr)	Annual Emissions[2] (tpy)
	Natural Gas Fired	
Nitrogen Oxides (NO_x)	19.8	173.4
Sulfur Dioxide (SO_2)	4.9	42.9
Particulate Matter with an aerodynamic diameter less than 10 microns (PM-10)	19.1	167.3
Sulfuric Acid Mist (H_2SO_4)	3.4	29.8

[1]Maximum short-term emission rates based on one (1) GE 7FA.05 combustion turbine. Emission rates include maximum level of duct firing.
[2]Annual emissions based on two (2) GE 7FA.05 combustion turbines operating at 8,760 hours per year.

The Brigantine Wilderness Class I area located in the Edwin B. Forsythe National Wildlife Refuge in New Jersey is approximately 108 km south of the proposed facility. Following the Draft Revised FLAG guidance (2010), TRC believes that the proposed facility may be eligible for an exemption from the requirement to perform a Class I area AQRV modeling analysis because of its inherent low emissions and distance to the Class I area.

We understand that the maximum short-term emission rates are used in the exemption analysis. Assuming full year operation (8,760 hours) of the combined cycle combustion turbine at the Keasbey Energy Center (firing ULSD) yields a (emission in tpy)/(distance in km) "Q/D" ratio (588 tons per year/108 km) of approximately 5.4. It should be noted that this assumption is conservative since the combustion turbine will only be capable of firing ULSD for up to 720 hours per year.

Similarly, assuming full year operation (8,760 hours) of the two (2) combined cycle combustion turbines at the Woodbridge Energy Center yields a (emission in tpy)/(distance in km) ratio (413 tons per year/108 km) of approximately 3.8.

The resulting Q/D ratio after combining the emissions of the existing Woodbridge Energy Center and the proposed Keasbey Energy Center, would be given by (588 tons + 413 tons)/(108 km), or approximately 9.3.

It is our understanding that according to the Q/D test, the FLM should consider this source (which is located greater than 50 km from the Brigantine Wilderness Class I area) and has a ratio of annual equivalent emissions (Q in tons per year) divided by distance (D in km) from the Brigantine Wilderness Class I area (km) < 10, as having negligible impacts with respect to Class I visibility impacts and that there would not be any Class I AQRV impact analyses required from this source.

With this revised letter, TRC, on behalf of CPV Keasbey, LLC, is again requesting a determination that there is no need to perform a Class I area AQRV analysis for the Brigantine Wilderness Area as part of the facility's PSD Air Permit application. If you should require additional information on the proposed Project or have any questions, please feel free to contact me at (201) 508-6960 or tmain@trcsolutions.com.

Sincerely,

TRC

Theodore Main

Theodore Main
Principal Consulting Meteorologist

cc: J. Donovan, CPV
A. Urquhart, CPV
M. Keller, TRC
TRC Project File 252973

Keller, Michael

From: Webster, Jill <jill_webster@fws.gov>
Sent: Tuesday, December 13, 2016 7:21 PM
To: Keller, Michael
Subject: Re: CPV Keasbey, LLC - (REVISED) Need for Class I AQRV Analyses for Brigantine Wilderness Area

Mr. Keller,

Thank you for sending the revised information. Based on the modifications to the project and the revised emissions (as provided in your letter dated, December 13, 2016), the Fish and Wildlife Service anticipates that modeling would not show any significant additional impacts to the air quality related values (AQRV) at the Brigantine Wilderness. Therefore, we do not request that a Class I modeling analysis be included with the permit application.

The state and/or EPA may have a different opinion regarding the need for a Class I increment analysis. Should this project change significantly again, please contact me directly so that we might re-evaluate the revised project.

On Tue, Dec 13, 2016 at 3:11 PM, Keller, Michael <MKeller@trcsolutions.com> wrote:

> Ms. Webster,
>
> In response to a comment from the NJDEP regarding the request for determination that there is no need to perform a Class I AQRV analysis for the Brigantine Wilderness Class I area that was submitted to your attention on July 12, 2016, TRC, on behalf of CPV Keasbey, LLC, is submitting this revised request.
>
> The Keasbey Energy Center will represent a significant modification of the Woodbridge Energy Center.
>
> The NJDEP has requested the Project send you a revised notification that includes the combined emissions of the existing Woodbridge Energy Center and the proposed Keasbey Energy Center.
>
> If you have any questions, please call or email.
>
> Thanks for your attention.

Michael

Michael D. Keller
Principal – Power Generation and Air Quality

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December 8, 2016
mk038-16

Ms. Jennifer Levy
New Jersey Department of Environmental Protection
Division of Air Quality, Bureau of Evaluation and Planning
401 East State Street, 2nd Floor
Trenton, New Jersey 08625

Subject: CPV Keasbey, LLC
Keasbey Energy Center
Proposed Combined Cycle Power Facility
Township of Woodbridge, Middlesex County, New Jersey
Response to Comments on the Air Quality Modeling Protocol

Dear Ms. Levy:

In response to the Bureau of Evaluation and Planning's comment response letter issued by you on October 25, 2016 relative to the proposed CPV Keasbey, LLC's Keasbey Energy Center Air Quality Modeling Protocol, please find below responses to questions/comments that were made. For ease of reference, each comment/question from your October 25, 2016 comment letter has been restated in bold with a response to the comment/question following. Also, per your request, please find attached a revised Air Quality Modeling Protocol that addresses the Bureau's comments and incorporates the responses below.

General Comments

Q1. Pollutant emissions from both the Keasbey Energy Center and the Woodbridge Energy Center must be evaluated together and their combined impact must comply with all state and federal regulations. This is consistent with the department's policy for phased projects with less than two years of contemporaneous operation. The combined impact of both facilities operations will need to be assessed and compared to the applicable significant impact levels; this will require a major revision to the protocol.

A1. Woodbridge Energy Center and Keasbey Energy Center will be evaluated together and their combined impacts will be compared to the Significant Impact Levels, PSD Class II increments, and NAAQS/NJAAQS. These revisions have been made and are reflected in the revised protocol.

Q2. CPV Keasbey needs to submit a site survey in accordance with the requirements set out in N.J.S.A. 45:8 et seq., NJ.AC. 13:40-1.1 et seq., and the Bureau's Technical Manual 1002. The survey should clearly show the location of all emission points to be modeled, building structures, elevations at the facility, drawn to scale, not reduced, and indicating true north. This plot plan should include the Woodbridge Energy center and the Keasbey Energy Center.

A2. A general arrangement site plan that fulfills the requirements set out in the Bureau's Technical Manual 1002 will be included as part of the air quality modeling portion of the air permit application. At the Department's request, this general arrangement site plan will include both the proposed Keasbey Energy Center and the existing Woodbridge Energy Center.

Q3. What is the contractual limit for sulfur content in the natural gas provided by your suppliers? CPV must use the contractual maximum gas fuel sulfur content in the estimation of its sulfur derived emissions for modeling purposes unless permit limits exist to ensure that the assumed sulfur content is not exceeded by the actual sulfur content. If limits exist, provide a b1ief overview of them in the protocol. If they do not exist, revise the SO2 emission rate along with any other pollutant emissions that would be impacted by the sulfur content.

A3. Natural gas sulfur content data was reviewed for the TETCO and TRANSCO gas suppliers. The TETCO data spans from October 1, 2013 to October 18, 2016, a period slightly more than three years. The TRANSCO data spans June 1, 2014 through June 7, 2016, a period slightly more than two years. This data also supplements the TRANSCO sulfur content data previously provided to the Bureau of Stationary Sources. The CPV Keasbey facility proposes to use either TRANSCO or TETCO gas supply.

The maximum daily sulfur content for either data is 0.55 grains/100 SCF, which is consistent with the maximum value of 0.63 grains/100 SCF used for the CPV Woodbridge facility permitting and for the emissions and performance data developed by GE for the CPV Keasbey 7HA.02 combustion turbine. The period average is about 0.2 grains/100 SCF. However, there are notable spikes in sulfur content throughout the period, namely the 0.63 grains/100 SCF presented in a prior set of data (provided to the Department), and at 0.55, 0.49, 0.385, and 0.372 in the current data sets. This demonstrates that spikes in sulfur content can and do occur within the gas supply and must be accounted for in the permitting process. As such, 0.63 is selected as the worst case sulfur content for short term sulfur dioxide emissions and for the combustion turbine performance. Note that while 0.63 grains S/100 SCF is the design basis sulfur content based on historical data, the actual natural gas sulfur content for gas to be supplied to the facility is wholly out of the control of CPV Keasbey.

These revisions have been made and are reflected in the revised protocol in Section 3.2.

Q4. Add a section to the protocol detailing how the PM2.5 increment analysis for both Class I and II will be performed. The PM2.5 SIL is no longer used to avoid a cumulative analysis of the increment except for the cases outlined in the guidance memorandum from US Environmental Protection Agency Guidance for PM-2.5 Permit Modeling, May 20, 2014 and in the August 18, 2016 EPA draft guidance memorandum. Include a discussion which addresses this guidance and how this will affect the CPV Keasbey PSD permit application.

A4. CPV Keasbey will incorporate the draft modeling guidance as provided in the U.S. EPA guidance memoranda dated May 20, 2014 and August 18, 2016 as they pertain to the modeling of PM-2.5 PSD Class I and II increments. Specifically, CPV Keasbey will use the following baseline dates to identify major and minor sources which may be included in a cumulative PSD increment assessment.

- The major source baseline date was established October 20, 2010.
- The minor source baseline date was established February 1, 2016.
- The area was designated attainment for PM-2.5 on September 4, 2013.

CPV Keasbey will work with the Department to develop an appropriate modeling inventory. This revision has been made and is reflected in the revised protocol in Section 5.12.

Section 1.0 Introduction

Q5. Page 1-1 states that the source is PSD affected for ozone (VOC). The area is nonattainment for ozone, thus subject to the nonattainment regulations with regard to ozone.

A5. This revision has been made and is reflected in the revised protocol in Section 1.0.

Section 3.1 Equipment/Fuels

Q6. List and detail the equipment from Woodbridge Energy Center that will be included in the air dispersion modeling demonstration.

A6. The equipment from the Woodbridge Energy Center that will be included in the air dispersion modeling demonstration will include the two (2) combustion turbines, the auxiliary boiler, the emergency diesel fire pump, the emergency diesel generator, and the 14-cell wet mechanical draft cooling tower. This revision has been made and is reflected in the revised protocol in Section 3.1 and Section 3.5.1.

Section 3.2 Operation

Q7. Provide details on the worst-case operating scenarios that will modeled for Keasbey Energy Center, the operating scenarios that were evaluated for Woodbridge Energy Center, and the worst-case operating scenarios from each of the power plants that may operate concurrently.

A7. The equipment from the proposed Keasbey Energy Center that will be included in the air quality dispersion modeling analyses will include the combined cycle combustion turbine, the emergency diesel generator, the emergency diesel fire pump, the auxiliary boiler, and the wet mechanical draft cooling tower. The worst-case combustion turbine operating scenario for each pollutant and averaging period will be determined.

The equipment from the existing Woodbridge Energy Center that will be included in the air dispersion modeling demonstration will include the two (2) combustion turbines, the auxiliary boiler, the emergency diesel fire pump, the emergency diesel generator, and the 14-cell wet mechanical draft cooling tower. The exhaust parameters and emission rates of the worst case operating scenarios for the existing Woodbridge Energy Center combustion turbine/heat recovery generator stacks can be found in Tables 3-7 and 3-8, respectively.

The existing Woodbridge Energy Center and the proposed Keasbey Energy Center will be evaluated together since they can operate concurrently and their combined impacts will be compared to the Significant Impact Levels, PSD Class II increments, and NAAQS/NJAAQS. This revision has been made and is reflected in the revised protocol in Section 3.3.

Section 3.3 Selection of Sources for Modeling

Q8. Calculations in Appendix B of the Keasbey Energy Center Combined Cycle Power Facility PSD Air Permit Application show that PM-10 emissions from the Keasbey Energy Center cooling tower will be greater than 1 lb/hr. The Department's Technical Manual 1002: Guideline on Air Quality Impact Modeling Analysis guidance states that cooling towers must be included in the air quality modeling when their PM-10 emissions exceed 1 lb/hr. Thus, it appears the PM-10 and PM-2.5 cooling tower emissions from both the Keasbey and Woodbridge power plants should be modeled.

A8. After discussions with the Department, since the combined PM-10 and PM-2.5 emissions from the cooling towers at Woodbridge and Keasbey exceed 1 lb/hr, both cooling towers will be including in the modeling analyses for PM-10 and PM-2.5 emissions. This revision has been made and is reflected in the revised protocol in Section 3.4.

Q9. Details on how the particulate emission rates are calculated and what assumptions are made for the cooling tower emissions, including vendor specifications, must be included in the modeling protocol and analysis. A professional journal from AWMA in 2002 is referenced as the source used to calculate the PM10/PM2.5 emissions from the cooling towers. The applicant should provide more updated literature search and also provide rational for not using AP42 emission factors. Confirm whether evaporative condensable emissions are considered from these units.

A9. Details on how the cooling tower particulate emissions rates are calculated with assumptions including vendor specifications are included in Section 3.4 and Appendix A of the protocol. The particle size calculation worksheet and droplet size distribution for an industry standard high efficiency drift eliminator is included in Appendix A of the protocol. The method used to calculate the emissions of PM10/PM2.5 were based on the procedure described in "Calculating Realistic PM10 Emissions from Cooling Towers" AWMA Abstract No. 216 Session No. AM-1b, Authors Joel Reisman and Gordon Frisbie, Greystone Environmental Consultants, Inc., 650 University Avenue, Suite 100, Sacramento, California 95825. The Reisman & Frisbie method is offered as a calculation method in addition to AP-42 for several important reasons. The first reason is that AP-42 is inadequate for determining PM2.5 emissions since it only provides a calculation for generic PM10 emissions. AP-42 assumes that all of the dissolved solids within the circulating water liquid drift leaving the cooling tower evaporates to form PM10 particles. (Table 13.4-1 AP-42 Section 13.4 Wet Cooling Towers, January 1995.) Second, this approach yields very conservative estimates for PM2.5 since its emissions would be equal to PM10. A third reason is that AP-42 does not account for the drift droplet spectrum from the drift eliminator which ultimately contributes to the particulate size range of evaporated solid particles. As BACT for cooling towers has been driven to drift rates of 0.0005% (and even lower in some cases) of the circulating water, the emitted spray drift droplets have preferentially been reduced in size, primarily due to higher drift eliminator efficiency scavenging the larger spray droplets.

An updated literature search was performed which sought a more current calculation method for particulate matter emissions calculations from wet cooling towers. As a rule, where PM10 and PM2.5 speciation of particulate matter from cooling towers is included in permit applications, the 2002 Reisman & Frisbie method is cited. Various examples were found, which include:

- Cooling Tower Institute (CTI), http://water-cti.com/pdf/PRWCTI-2011-001.pdf.
- State agency source guidance and/or applications including New Mexico, Washington and Florida.
    - https://www.env.nm.gov/aqb/permit/documents/PermittingGuidanceforCoolingTowerParticulateEmissions.pdf
    - http://www.ecy.wa.gov/programs/air/quincydatacenter/docs/Columbia-Revised-NOC-Water.pdf
    - https://www.dep.state.fl.us/air/emission/bioenergy/gainesville/mEmissionRates.pdf
    - Canadian Environment and Climate Change guidance for Wet Cooling Towers (https://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=2ED8CFA7-1 April 2014).

The reason the Reisman & Frisbie method is a widespread accepted use is that it follows an easily auditable approach and employs a simple mathematical transformation of the water droplets to solid particles. The spray drift droplets from the cooling tower drift eliminator can be measured and placed into a drift droplet size distribution, which is provided by the cooling tower vendor. Knowing the total dissolved particulate concentration within the circulating water and assuming that the drift droplets totally evaporate, the remaining evaporated particle size distribution is equivalent to the drift droplet size distribution. The total mass of particulate matter is calculated using the AP-42 emission factor method, and the subsequent PM10 and PM2.5 fractions are calculated from the evaporated droplet size distribution. The updated literature search did not uncover any alternative cooling tower particulate emission calculation method, or an improvement over the 2002 Reisman & Frisbie method.

With regard to evaporative condensable particulate matter being considered in the proposed Keasbey wet cooling tower emissions, there will be no such particulate matter. By the calculation method employed (either using AP-42 emissions factors, or AP-42 emissions adjusted for PM10 and PM2.5 as is the case employed by Keasbey Energy Center), the emission calculation only considers the evaporation of the water within the drift droplets. There will be no emissions of volatile constituents that may subsequently condense (in the atmosphere) to form condensable particulate matter.

Q10. Please clarify the discrepancy between pages 3-2 and 3-5 regarding the modeling of the emergency generator and fire pump. To be clear, these units are not automatically exempt from modeling. Furthermore, the exemption given in the referenced EPA March 11, 2011 memo is only for the probabilistic 1-hour average NAAQS only. For example, it is not for carbon monoxide since carbon monoxide is not a probabilistic standard. It is also not for PM2.5 since this is a daily average. The reason some exemptions may be considered by the reviewing agencies is that the occurrence of that emission scenario is so infrequent and short duration that the likelihood of it occurring during the hour of the worst case meteorology is low. Therefore, it is not likely that the sporadic occurrence of that exempt emission scenario would lead to an exceedance of the NAAQS. In addition, the fact that it would be modeled as a continuous emission scenario for 8760 hours per year may be overly conservative. It was not clear that the applicant intended to show this low probability in the protocol. The same EPA March 11, 2011 guidance did not provide a blanket exemption, especially to testing and maintenance of these emergency equipment where this activity may be scheduled and is routine. In this case the testing and maintenance proposed for 100 hours per year should still be examined further before granting the exemption. EPA also understands that NJDEP has developed guidance in this respect but provides this guidance in addition to the NJDEP guidance.

A10. The emergency diesel generators and emergency diesel fire pumps at both Woodbridge and Keasbey will not be included in the 1-hour SO_2 and 1-hour NO_2 modeling analyses, per the exemption as defined in the July 29, 2011 policy memorandum issued by NJDEP exempting emergency generator and fire pump NO_x and SO_2 emissions from 1-hour NO_2 and SO_2 air quality modeling at combined cycle turbine facilities. CPV has already agreed to the permit conditions contained in the aforementioned policy memorandum for the emergency diesel fire pump and emergency diesel generator at Woodbridge and proposes to agree to the same conditions for Keasbey. The emergency diesel generators and emergency diesel fire pumps will be included in the modeling analyses for all other pollutants and averaging periods. This revision has been made and is reflected in the revised protocol in Section 3.5.

Section 3.4 Exhaust Stack Configuration and Emission Parameters

Q11. Provide explanation and units for the 2.06 value used in the SO2 calculations and 0.8 and 1.74 values used in the NOx calculations.

A11. For the SO_2 calculation, 2.06 = molecular weight of ammonium sulfate (132 g/mol) divided by the molecular weight of sulfur dioxide (64 g/mol). For the NO_2 calculation, 1.74 = molecular weight of ammonium nitrate (80 g/mol) divided by the molecular weight of nitrogen dioxide (46 g/mol); and, 0.8 = application of the ambient ratio method (Tier 2) NO to NO_2 conversion rate to the NO_x emission rate. These revisions have been made and are reflected in the revised protocol in Section 3.5.

Q12. Move Woodbridge Energy Center Source parameter tables forward from Appendix B.

A12. This revision has been made and is reflected in the revised protocol in Tables 3-3c, 3-3d, 3-7, 3-8, 3-9, 3-10, and 3-11 respectively.

Section 3.5 GEP Analysis

Q13. Provide a table identifying all buildings on and off site with the potential to cause aerodynamic downwash of emissions from the stack. This analysis need only consider buildings within 0.8 kilometer or 5 L from the stack, whichever is lesser. For each stack, a table shall be provided with the following data for each building (or tier):

- **a. Building height (relative to stack base elevation);**
- **b. Maximum projected building width;**
- **c. Distance from the stack;**
- **d. 5L distance; and**
- **e. Calculated formula GEP stack height.**

A13. A GEP analysis table that provides the aforementioned data will be included as part of the air quality modeling portion of the air permit application.

Tables 3-1a and 3-1b

Q14. Will the facility operate in simple cycle mode?

A14. The proposed facility (Keasbey Energy Center) will not operate in simple cycle mode. This clarification has been made and is reflected in the revised protocol in Section 3.3.

Q15. The text suggest that these tables are the combined parameters for the combustion turbine and the HRSG. If that is correct, please modify the table name to reflect this.

A15. These revisions have been made and are reflected in the revised protocol in Tables 3-1a, 3-1b, and 3-2, respectively.

Q16. Define the stack height in the footnote.

A16. This revision has been made and is reflected in the revised protocol in Tables 3-1a and 3-1b, respectively.

Table 3-3

Q17. Please add location coordinates and an elevation to the table for consistency.

A17. This revision has been made and is reflected in the revised protocol in Tables 3-3a and 3-3b, respectively.

Q18. Provide cooling tower parameters for Woodbridge Energy Center. See comment 12.

A18. This revision has been made and is reflected in the revised protocol in Table 3-3c.

4.1.2 Prevention of Significant Deterioration

Q19. The text states that if the modeled concentrations are less than the SILs, then NAAQ S and increments analyses are not required. Due to a court decision in 2013, this is not a blanket conclusion. More recent EPA guidance, such as the May 2014 PM2.5 guidance is recommended for other pollutants as well. It states that the applicant and reviewing agencies examine existing conditions to ensure that a NAAQS or increment could not be exceeded even with de minimis impacts. Even recent draft guidance for O3/PM2.5 SILs reiterates that SILs are discretionary especially in areas with significant growth (August 18, 2016). The increment will need to be evaluated.

A19. CPV Keasbey, LLC recognizes the concern of the Department that simply achieving a SIL is not necessarily protective of the ambient standard. As such, Table 5-5 of the protocol has been revised to include the proposed representative background concentration, applicable ambient air quality standard, the SIL, and the delta between the AAQS and background concentration in order to demonstrate there is adequate margin between the AAQS and background concentrations to support the facility air quality impact if below the SIL.

Q20. The interim SIL value of 10.0 ug/m3 for the 1 hour NO2 may be used for the initial impact analysis. However, should a violation be found, the proposed EPA SIL of 7.5 ug/m3 should be used for the NAAQS analysis. The text needs clarification explaining where the interim value comes from and justification for the value (see "NESCAUM Recommendations on the Use of an Interim Significant Impact Level (SIL) in Modeling the 1-Hour NO2 NAAQS", Northeastern States for Coordinated Air Use Management, April 21, 2010). Please include this

document in Appendix A.

A20. While the Project understands the NESCAUM interim SIL of 10 ug/m^3 is allowed, in the interest of conservatism, the Project has assumed the more restrictive U.S. EPA Interim SIL of 7.5 ug/m^3 for the related air quality modeling analyses. Therefore, footnote "b" in Table 4-2c has been revised to reference "Proposed SIL of 7.5 ug/m^3 per June 29, 2010 memorandum "Guidance Concerning the Implementation of the 1-Hour NO_2 NAAQS for the PSD Program" from U.S. EPA".

Q21. Include both the Class I and II SILs and PSD Increments in the discussion.

A21. This revision has been made and is reflected in the revised protocol in Section 4.1.2 and Tables 4-2b, 4-2c, and 4-2d.

Q22. The text states that NJDEP administers the PSD program under 40 CFR 51.166 and they received delegation in February 22, 1983. This should be corrected. NJDEP administers the PSD program under the federal rules of 40 CPR 52.21. The delegation agreement was updated on July 15, 2011.

A22. This revision has been made and is reflected in the revised protocol in Section 4.1.2.

4.1.3 Preconstruction Ambient Air Quality Monitoring Exemption

Q23. While not part of this modeling protocol, a response to EPA's July 26, 2016 comments on the preconstruction ambient monitoring waiver request remains outstanding. In addition, the request should be revised to include pertinent information regarding the Woodbridge power plant.

A23. The applicant will provide a response to the U.S. EPA Regions II's July 26, 2016 comments on the July 12, 2016 preconstruction ambient monitoring waiver request under a separate cover. At the Department's request, the request will include the pertinent information regarding the Woodbridge Energy Center. This revision has been made and is reflected in the revised protocol in Section 4.1.3.

Table 4-1

Q24. Remove preliminary from the column name. Please be aware that should facility emission rates change, air dispersion modeling may have to be redone.

A24. This revision has been made and is reflected in the revised protocol in Table 4-1.

Q25. Include a column showing the emissions from just the Keasbey Energy Center and a column showing the total emissions when combining the Keasbey and Woodbridge power plant emissions.

A25. This revision has been made and is reflected in the revised protocol in Table 4-1.

Q26. Clarify in a footnote or the table title whether the emission rates presented refer to all equipment or a subset of the equipment.

A26. In Table 4-1, the emission rates in the columns "Keasbey Energy Center Emission Rate" and "Woodbridge Energy Center Emission Rate" refer to all equipment at each respective facility. This clarification has been made and is reflected in the revised protocol in a footnote in Table 4-1.

Table 4-2

Q27. Please add Class I SIL and PSD values to this table.

A27. Table 4-2d has been added in the revised protocol to show Class I SILs and Class I PSD increment values.

Q28. BEP would prefer that the information in footnote a be presented in a separate table showing how the modeling results will be used to calculate the value for each pollutant and applicable averaging time to show compliance with NAAQS, SILs and NJAAQS. Please include information about the annual averaging times and about the lead assessment.

A28. The footnote revisions have been made and are reflected in the revised protocol in Tables 4-2a, 4-2b, 4-2c, and 4-3. In the case of lead, the rolling 3-month period maximum will be conservatively estimated from the 24-hour concentration. This revision has been made and is reflected in the revised protocol in Section 5.8.

Q29. Typo in footnote "a": The 24-hour PM2.5 NAAQS is a 3 year average of the 98th percentile. The word "average" should be included (similar to the 1 hour NO2 or SO2.)

A29. This revision has been made and is reflected in the revised protocol in Table 4-2a.

Q30. Footnote "b" should reference the NESCAUM recommendation. See "NESCAUM Recommendations on the Use of an Interim Significant Impact Level (SIL) in Modeling the 1-Hour NO2 NAAQS"; Northeastern States for Coordinated Air Use Management; April 21, 2010. Include this document in appendix A.

A30. While the Project understands the NESCAUM interim SIL of 10 ug/m^3 is allowed, in the interest of conservatism, the Project has assumed the more restrictive U.S. EPA Interim SIL of 7.5 ug/m^3 for the related air quality modeling analyses. Therefore, footnote "b" in Table 4-2c has been revised to reference "Proposed SIL of 7.5 ug/m^3 per June 29, 2010 memorandum "Guidance concerning the Implementation of the 1-Hour NO_2 NAAQS for the PSD Program" from U.S. EPA".

Section 5.2 Surrounding Area and Land Use

Q31. BEP agrees that the rural land use option can be used. As discussed in the Air Quality Permitting Program's Technical Manual 1002 Section 6.4.1, the land use analysis should be based on the Auer Land Use Classification method using the latest available USGS topographic maps, the percentage of each land use type, and the total percentages of urban versus rural landscape should be provided.

A31. This revision has been made and is reflected in the revised protocol in Section 5.2 and Figure 5-1b.

Section 5.3 Meteorological Data

Q32. Provide a better justification for why Brookhaven upper air was chosen for the study. For example, "the next most proximate upper air station is XX ..."

A32. This revision has been made and is reflected in the revised protocol in Section 5.3.

Section 5.5 Load analysis

Q33. Add NJAAQS to the list of assessments.

A33. This revision has been made and is reflected in the revised protocol in Section 5.5.

Q34. Provide details on the worst-case operating scenarios that will modeled for Keasbey Energy Center, the operating scenarios that were evaluated for Woodbridge Energy Center, and the worst-case operating scenarios from each of the power plants that may operate concurrently.

A34. The equipment from the proposed Keasbey Energy Center that will be included in the air quality dispersion modeling analyses are the combined cycle combustion turbine, the emergency diesel generator, the emergency diesel fire pump, the auxiliary boiler, and the wet mechanical draft cooling tower. The worst-case combustion turbine operating scenario for each pollutant and averaging period will be determined.

The equipment from the existing Woodbridge Energy Center that will be included in the air dispersion modeling demonstration are the two (2) combustion turbines, the auxiliary boiler, the emergency diesel fire pump, the emergency diesel generator, and the 14-cell wet mechanical draft cooling tower. The exhaust parameters and emission rates of the worst case operating scenarios for the existing Woodbridge Energy Center combustion turbine/heat recovery generator stacks can be found in Tables 3-7 and 3-8, respectively.

The existing Woodbridge Energy Center and the proposed Keasbey Energy Center will be evaluated together since they can operate concurrently and their combined impacts will be compared to the Significant Impact Levels, PSD Class II increments, and NAAQS/NJAAQS. This revision has been made and is reflected in the revised protocol in Section 3.3.

Q35. Please provide calculations of the exhaust velocity from Tables 3-1a and 3-1b, for the various operating loads.

A35. Sample calculations of the exhaust velocity are provided below Tables 3-1a and 3-1b, respectively.

Section 5.6 Startups/Shutdowns

Q36. Modeling analysis for the startup and shutdown conditions will need to evaluate emissions of all criteria pollutants with short-term NAAQS and all startup types (warm, hot, cold) for natural gas operations. Startup numbers should be based on combined operation of both power plants.

A36. These revisions have been made and are reflected in the revised protocol in Sections 5.6 (SUSD – Keasbey Energy Center) and 5.6.1 (SUSD – Woodbridge Energy Center), as well as in Tables 5-1, 5-2, 5-3, and 5-4. Concurrent startups at both Woodbridge and Keasbey could occur and will be modeled accordingly.

Q37. Will there be concurrent startups for both power plants? If so, please detail how the scenario(s) will be modeled. Emissions will need to include operations at the Woodbridge Energy Center and all operating scenarios listed in the Keasbey Permit application.

A37. Concurrent startups at both Woodbridge and Keasbey could occur and will be modeled accordingly. These revisions have been made and are reflected in the revised protocol in Sections 5.6 (SUSD – Keasbey Energy Center) and 5.6.1 (SUSD – Woodbridge Energy Center), as well as in Tables 5-1, 5-2, 5-3, and 5-4.

Q38. It is stated that the scenario will be modeled if the pollutant(s) has a higher emissions during startup and shutdown conditions when compared to normal operation. This is not acceptable since the impacts may be higher given the reduced stack flow and stack temperature. These impacts must be assessed.

A38. This revision has been made and is reflected in the revised protocol in Section 5.6. The need for additional modeling to account for predicted short-term project impacts during startup of the combined cycle unit will be assessed for criteria pollutants for which a short-term NAAQS or PSD increment has been defined.

Q39. Startup under ULSD are not proposed since they are limited to 10-20 (two power plants) of these startups per year and the applicant claims these could be considered transient. Perhaps this may be true for the probabilistic 1 hour NO2 or 1 hour SO2 NAAQS demonstrations but this is not true for the CO NAAQS since they are based on a different statistic.

A39. During the operational year, CPV Keasbey, LLC is proposing ten (10) ULSD fired rapid starts. ULSD fired rapid starts are not proposed to be evaluated for 1-hour NO_2 since the number of each (10) can be deemed to be transient events. ULSD fired rapid starts will be evaluated for 1-hour and 8-hour CO. These revisions have been made and are reflected in the revised protocol in Section 5.6.

Q40. Please clarify further what is meant on page 5-5, "Since SO2 emissions are strictly dependent upon fuel flow (and lower during startup than continuous operation), SO2 startups are not proposed to be evaluated."

A40. Unlike NO_x, CO, and VOC emissions which result from atypical combustion during the transient operating conditions that occur during the combustion turbine start and which are typically higher than during normal operation, the SO_2 emissions are only due to the quantity of sulfur compounds in the fuel and the amount of fuel combusted during the start. Since the fuel flow is lower during a start than during normal (or continuous) operation, the SO_2 emissions will likewise be lower and will be less than the emissions during the minimum operating load. Keasbey Energy Center proposes to assess SO_2 emissions at multiple operating loads including the minimum emissions compliance load (MECL). As such the SO_2 modeling of normal operation at minimum load will adequately assess the potential air quality impact due to SO_2 emissions at low loads including the startup conditions. This revision has been made and is reflected in the revised protocol in Section 5.6.

Section 5.7 1-hour NO2 Modeling

Q41. It is unclear if the emergency diesel generator and emergency diesel fire pump are the only pieces of equipment CPV is proposing be exempt from the 1 hour NO2 modeling requirement. Provide clarification. Additionally, include a reference to the NJDEP policy memorandum used to justify exemption from modeling requirements. Ensure that the proposal to not include the fire pump and emergency generator conforms to the Departments' policy memorandum dated July 2011 Exempting Emergency Generator and Fire Pump Nitrogen Oxide (NO2) and Sulfur Dioxide (SO2) Emissions from 1-hour NO2 and SO2 Air Quality Modeling. Provide information in the protocol about whether all conditions in the above referenced memo are met by permit conditions.

A41. The emergency diesel generators and emergency diesel fire pumps at both Woodbridge and Keasbey will not be included in the 1-hour SO_2 and 1-hour NO_2 modeling analyses, per the exemption as defined in the July 29, 2011 policy memorandum issued by NJDEP exempting emergency generator and fire pump NO_x and SO_2 emissions from 1-hour NO_2 and SO_2 air quality modeling at combined cycle turbine facilities. CPV has already agreed to the permit conditions contained in the aforementioned policy memorandum for the emergency diesel fire pump and emergency diesel generator at Woodbridge and proposes to agree to the same conditions for Keasbey. The other combustion sources at Woodbridge (combustion turbines and auxiliary boiler) and Keasbey (combustion turbine and auxiliary boiler) will be included in the 1-hour NO_2 modeling analyses. This revision has been made and is reflected in the revised protocol in Section 5.7.

Q42. Include the auxiliary boiler in this section's discussion. In addition, provide details on the Woodbridge Energy Center sources that will be included in the 1-hour NO2 NAAQS compliance demonstration.

A42. The only Woodbridge Energy Center sources that will not be included in the 1-hour NO_2 modeling analyses are the emergency diesel generator and emergency diesel fire pump. The other combustion sources at Woodbridge (combustion turbines and auxiliary boiler) will be included in the 1-hour NO_2 modeling analyses. This revision has been made and is reflected in the revised protocol in Section 5.7.

Q43. The protocol should provide more information regarding how the 1 hour NO2 modeling will be undertaken. The protocol simply states that the EPA guidance will be used including the September 30, 2014 guidance. This September guidance relates to the beta ARM2 technique which require more detail on how it will be implemented (e.g., in-stack ratios, and ambient ozone data). It is not clear if the applicant intends to use this technique or was simply listing guidance that is available. If the applicant proposes to use the beta ARM2 technique, they should send EPA Region 2 the proposal for approval. In either case, more details are needed for the 1 hour NO2 modeling procedure.

A43. The following tiered screening options will be applied for the various analyses per the guidance specified in the U.S. EPA Memorandum "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard" section entitled Approval and Application of Tiering Approach for NO_2 (found on pages 5 through 8 of the memorandum). The applicant proposes to use the Tier 2 screening approach for initial modeling results with the default ambient ratios for 1-hour (0.8) and annual (0.75). This method will be applied to both the SIL and NAAQS/increment analyses, respectively for the 1-hour and annual averages. Note that the applicant may also propose the use of the Tier 3 screening approach applying PVMRM should the Tier 2 method prove too conservative. Should the applicant decide to propose this approach, approval for the use of Tier 3, using the default in-stack ratio of 0.5 and a default NO_2/NO_x ambient equivalent ratio of 0.9, will be requested from U.S. EPA Region 2. This method will be employed if the modeled Tier 2 concentration plus a representative background concentration exceeds the NAAQS. This revision has been made and is reflected in the revised protocol in Section 5.7.

Section 5.8 NJDEP Air Toxics Risk Analysis

Q44. Include all of the sources at the Keasbey and Woodbridge Energy Centers, including tanks, for comparison to air toxic substance unit risk factors and reference concentrations. The bureau recommends the use of AERMOD for a risk assessment rather than multiple and non-concurrent evaluations of risk using the Risk Screening Worksheet.

A44. To assess the potential for offsite public health threats, the NJDEP Technical

Manual 1003: Guidance on Preparing a Risk Assessment Protocol for Air Contaminant Emissions will be used. The NJDEP has prescribed and provided an Air Toxics Risk Screening Worksheet to ascertain the potential health effects from facilities seeking permits to emit air toxics. TRC proposes to model (using AERMOD) the 24-hour and annual concentrations from those HAPs which are above the Subchapter 22 reporting threshold emission rates. The combined concentrations from Keasbey and Woodbridge will be evaluated against the reference concentrations found in the NJDEP Risk Technical Manual 1003 and risk screening worksheet. This revision has been made and is reflected in the revised protocol in Section 5.8.

Section 5.9 Receptor Grid

Q45. Discuss placing elevated receptors at the Fresh Kills Landfill on Staten Island, New York.

A45. At the Department's request, elevated receptors were placed at the Fresh Kills Landfill on Staten Island, New York. Data from the New York City Department of City Planning was used to accurately define elevations in this area. A total of 29 receptors within the current modeling domain were adjusted to reflect the final contours of the piles, while 6 additional receptors were added corresponding to the highest point at each of the 6 major landfill piles. For these 35 receptors, it was necessary to adjust the "scale height" parameter, as AERMOD will not accept a receptor with a "scale height" value that is less than the elevation of the receptor. As such, the "scale height" parameter was set equal to the receptor elevation for these receptors. A list of the 35 Fresh Kills Landfill receptors is provided in Table 5-6. This revision has been made and is reflected in the revised protocol in Section 5.9.

Q46. As discussed in the Air Quality Permitting Program's Technical Manual 1002 Section 9.1, fine grids of 50 m should be placed over the areas of maximum concentration to ensure that the true maximum concentration is identified.

A46. At the NJDEP's request, an additional model run will be executed with additional receptors with a spacing of 50 meters placed in the area of maximum impacts. This revision has been made and is reflected in the revised protocol in Section 5.9.

5.11 NAAQS/NJAAQS Analysis

Q47. Please confirm that NAAQS/NJAAQS will be evaluated by showing that the impacts plus the ambient background are less than the NAAQS/NJAAQS values for applicable averaging periods, even if the impacts are less than the SIL.

A47. The NAAQS/NJAAQS will be evaluated by showing that the impact plus the ambient background are less than the NAAQS/NJAAQS values for applicable averaging periods. This revision has been made and is reflected in the revised protocol in Section 5.11.

Q48. Since the combined emissions from both power centers for SO2 will be above the 40 tons/yr threshold, an air dispersion modeling demonstration for the 1 hour SO2 NAAQs and SO2 increments (3 hour, 24 hour and annual average) must be included.

A48. An air quality modeling analysis will be performed to show that the combined impacts of the proposed facility (Keasbey Energy Center) and the existing Woodbridge Energy Center plus the ambient background are less than the 1-hour and 3-hour SO_2 NAAQS. Additionally, an air quality modeling analysis will also be performed to show that the combined impacts of the proposed facility (Keasbey Energy Center) and the existing Woodbridge Energy Center are less than the 3-hour, 24-hour, and annual SO_2 PSD Class II increments.

5.12 PSD Increment Analysis

Q49. Comparison to Significant Impact Levels does not determine whether demonstrating compliance with PSD increments is required. Since this project's total emissions trigger PSD review, the modeling analysis should compare Keasbey and Woodbridge Energy Centers combined impacts to PSD Class I and Class II Increments.

A49. This revision has been made and is reflected in the revised protocol in Section 5.12.

5.15.2 Assessment of Impacts on Soils and Vegetation

Q50. BEP recommends using compliance with NJAAQS and NAAQS combined with the screening criteria for SO2 shown in the table below as an acceptable demonstration for protection of vegetation.

a) The screening value is based on the sensitive vegetation screening value in A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals (EPA document 450/2-81-078). This value should be compared to the maximum average ambient air concentration plus background for the specified averaging period.

A50. This revision has been made and is reflected in the revised protocol and Table 5-7.

5.15.3 Impact on Visibility

Q51. Provide a brief overview of the model, details on the methodology for running the model, and criteria that will be used to interpret the results from VISCREEN model. Visibility modeling should include emissions from the cooling towers.

A51. This revision has been made and is reflected in the revised protocol in Section 5.15.3. This modeling will include emissions from the cooling towers.

5.15.4 Impacts on Class I Areas

Q52. It appears that the Federal Land Manager was notified of the Keasbey Energy Center without including information pertaining to the Woodbridge Energy Center. Please re-contact and notify the FLM of the combined emissions of the two power plants for their evaluation.

A52. At the Department's request, the applicant will notify the FLM of the combined emissions of Keasbey Energy Center and Woodbridge Energy Center. Correspondence by and between the applicant and the FLM will be submitted under a separate cover. This revision has been made and is reflected in the revised protocol in Section 5.15.4.

Q53. While the FLM provided a waiver to address the AQRV in Brigantine, the Class I increment must be considered since the source is only 108 km distance.

A53. This revision has been made and is reflected in the revised protocol in Section 5.15.4.

Q54. For comparison of Class I SILs and PSD Increments, predicted impact concentrations at receptors at distance of 50 km from the Keasbey/Woodbridge site in the radial direction of the Class I Area located at the Brigantine Edwin B. Forsythe National Wildlife Refuge will be required.

A54. This revision has been made and is reflected in the revised protocol in Section 5.15.4.

Tables 5.1 and 5.2

Q55. Startup event emissions and hourly emissions should not be identical as the startup emissions are proposed to be prorated to the duration of startup time.

A55. Since the startup pound per event emissions occur during a time period less than 1-hour, the pound per event value is the same as the pound per hour value, specifically for the 1-hour averaging period. For the remainder of the hour, the worst-case pollutant operating scenario emission rate is prorated. As previously stated in Section 5.6 of protocol, for those averaging periods that extend beyond the start-up duration (i.e., 8-hour), modeled concentrations will be determined based on the combination of the startup conditions for the appropriate amount of time and the worst-case pollutant and averaging period specific operating scenario prorated for the remainder of the averaging period. Please see the revised text in Section 5.6 that describes the worst-case modeling scenarios during startup and shutdown.

Table 5.3

Q56. Add a column to the table specifying the monitoring stations used to provide ambient air concentrations.

A56. This revision has been made and is reflected in the revised protocol in Table 5-5.

Q57. The 2015 3-Hour SO2 ambient air concentration at Elizabeth Lab is 55.0 ug/m3. This 2015 value should be used as the background value for any NAAQS analysis.

A57. This revision has been made and is reflected in the revised protocol in Table 5-5.

Q58. In footnote b, the 1-hour 3-year average 98th percentile for NO2 should be 84.91 ug/m3.

A58. This revision has been made and is reflected in the revised protocol in Table 5-5.

Please feel free to contact me at 201-508-6954 or Ted Main at 201-508-6960 should you have any additional questions. We look forward to continuing to work with you on this project.

Sincerely,

TRC

Michael D. Keller

Michael D. Keller
Principal – Power Generation and Air Quality

Attachment

cc: G. John, NJDEP
A. Colecchia, U.S. EPA Region II
J. Donovan, CPV
A. Urquhart, CPV
T. Main, TRC
TRC Project File 252973

mk038-16.ltr.doc

CHRIS CHRISTIE
Governor

KIM GUADAGNO
Lt. Governor

DEPARTMENT OF ENVIRONMENTAL PROTECTION
AIR QUALITY, ENERGY AND SUSTAINABILITY
DIVISION OF AIR QUALITY
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BOB MARTIN
Commissioner

MEMORANDUM

TO: Aliya Khan, Bureau of Stationary Sources

FROM: Jennifer Levy, Bureau of Evaluation and Planning

DATE: January 25, 2016

SUBJECT: CPV Keasbey, LLC
Air Quality Modeling Protocol dated August 2016
(revised December 2016)
Woodbridge, Middlesex County, New Jersey
PI# 55824 BOP Application Number 160004

CPV Keasbey, LLC is proposing to construct and operate a new 630 MW combined cycle unit, identified as Keasbey Energy Center, directly adjacent to the 725 MW Woodbridge Energy Center, in Woodbridge, Middlesex County, New Jersey. The Keasbey Energy Center will consist of one dual fuel (natural gas or ultra-low sulfur diesel oil) General Electric 7HA.02 combustion turbine, one heat recovery steam generator, one natural gas-fired auxiliary boiler, one emergency diesel generator, one emergency diesel fire pump, a steam turbine generator, and a wet mechanical draft cooling tower. Control devices include dry low-NOx combustors, water injection, selective catalytic reduction (SRC), and oxidation catalyst.

The proposed project will be subject to PSD review for Greenhouse Gases(GHG), nitrogen oxides (NO_x), particulate matter less than 10 microns (PM_{10}), particulate matter less than 2.5 microns($PM_{2.5}$), carbon monoxide(CO), sulfuric acid mist (H_2SO_4), and sulfur dioxide (SO_2). The project will be subject to non- attainment new source review for NO_x and volatile organic compounds (VOC).

The Bureau of Evaluation and Planning (BEP) in collaboration with EPA Region II has completed its initial review of the above referenced document. The attached comments should be addressed in the form of a revised modeling protocol. If there are any questions regarding the attached comments, contact Jennifer Levy at (609) 633-8239.

cc:
Bachir Bouzid (BOsS)
Danny Wong (BEP)
Joel Leon (BEP)
Greg John (BEP)
Annamaria Colecchia (EPA- emailed)
Ted Main (TRC)
Michael Keller (TRC)

Bureau of Evaluation and Planning Comments on the CPV Keasbey, LLC Air Quality Modeling Protocol, Dated August, 2016 (Revised December 16)

General comments

1) CPV Keasbey needs to submit a site survey in accordance with the requirements set out in N.J.S.A. 45:8 et seq., N.J.A.C. 13:40-1.1 et seq., and the Bureau's Technical Manual 1002. The survey should clearly show the location of all emission points to be modeled, building structures, elevations at the facility, drawn to scale, not reduced, and indicating true north. This plot plan should include the Woodbridge Energy center and the Keasbey Energy Center.

2) All maps should clearly identify the Keasbey and Woodbridge Energy Centers and should present the ambient air boundary around the combined facility.

Section 1.0 Introduction

1) Modeling for Woodbridge Energy Center cannot be based on the previous modeling from 2012. Modeling must be completed using the current version of AERMOD (version 16216), the current version of AERMET (version 16216), and the current meteorological dataset (2010-2014). All permitted operating scenarios must be evaluated for Woodbridge Energy Center.

2) Add NOx to the pollutant list subject to PSD permitting.

3) Provide clarification to the statement that NO_x modeling is required due to NO_x being an ozone precursor on page 1-2. NO_x has to be modeled because it is above PSD Significant Emission Rates.

Section 2.0 Area Description

4) For figure 2-1, show the location of Woodbridge Energy Center.

5) For figure 2-2, identify the location of Woodbridge Energy Center and add a legend to clarify what the red regions represent.

Section 3.2 Fuels

6) Provide a description of the fuel types used at Woodbridge Energy Center. In this section and the previous section, please provide more details for Woodbridge Energy Center.

Section 3.3 Operation

7) Provide details on the operation restrictions for Woodbridge Energy Center, similar to the description for the Keasbey Energy Center.

Section 3.5.1 Exhaust and Emission parameters (Woodbridge Energy Center)

8) Provide details on all operating scenarios to be evaluated for Woodbridge Energy Center and comment on the operating scenarios from each of the power plants that may operate concurrently. See comment #1.

9) Add a section to the protocol describing how the operating scenarios from both Keasbey Energy Center and Woodbridge Energy Center will be selected for the combined modeling of both facilities.

10) For figure 3-1, include Woodbridge Energy Facility on the map.

11) Replace tables 3-7 and 3-8 with tables similar to 3-1a, 3-1b, and 3-2 to detail the load analysis for Woodbridge Energy Center.

Section 3.6 GEP Analysis

12) Provide a table identifying all buildings on and off site with the potential to cause aerodynamic downwash of emissions from the Keasbey and Woodbridge stacks. This analysis need only consider buildings within 0.8 kilometer or 5 L from the stack, whichever is lesser. For each stack, a table shall be provided with the following data for each building (or tier):

a. Building height (relative to stack base elevation);
b. Maximum projected building width;
c. Distance from the stack;
d. 5L distance; and
e. Calculated formula GEP stack height.

4.1.2 Prevention of Significant Deterioration

13) The text states that if the modeled concentrations are less than the SILs, then NAAQS and increments analyses are not required. Due to a court decision in 2013, this is not a blanket conclusion. More recent EPA guidance, such as the May 2014 PM2.5 guidance is recommended for other pollutants as well. It states that the applicant and reviewing agencies examine existing conditions to ensure that a NAAQS or increment could not be exceeded even with de minimis impacts. Even recent draft guidance for O3/PM2.5 SILs reiterates that SILs are discretionary especially in areas with significant growth (August 18, 2016). Compliance with $PM_{2.5}$ increment will need to be addressed.

Update the text to reflect the current EPA guidance and provide a discussion to support your argument that NAAQS and increment could not be exceeded even with de minimis impacts. The information in Table 5-5 can be used to support the NAAQS argument but does not address the increment.

Table 4-2a

14) The 8-hour ozone NAAQS value is incorrect. Revise it to reflect the 0.07 ppm standard.

15) Typo in footnote "d": The 24-hour PM2.5 NAAQS is a 3 year average of the 98^{th} percentile.

16) Footnote "h: the modeled concentration should be conservatively estimate from the maximum 24-hour concentration. Please insert the word "maximum".

17) Please add a footnote saying that the 24-hour and annual SO_2 averaging periods will be modeled for comparison to the SILs and NJAAQS.

Table 4-2c

18) Please include the proposed ozone SIL of 1 ppb to this table.

Section 5.5 Load analysis

19) A load analysis for all permitted operating scenarios must be evaluated for Woodbridge Energy Center as well as Keasbey Energy Center. Provide details for the operating scenarios that will be evaluated for the Woodbridge Energy Center. See comment #1.

20) The "worst-case" loads for Keasbey and Woodbridge Energy centers may not produce the "worst-case" scenario for their combined operation. Assessment of air quality standards must be based on the combined "worst-case" operations of the facilities.

    When presenting the modeling results, provide a matrix showing the worst case air concentrations for each pollutant, averaging time, and operating scenario for both facilities. This should include continuous operations and startup/shutdown scenarios. If scenarios operate for 3 hours or less, then they do not need to be evaluated for longer averaging times (ex. Startup and Shutdown). The results should be used to determine the operating scenarios from each of the power plants that will be modeled concurrently to identify the "worst-case" combined operation. The results for the individual operating scenarios should be discussed with BEP to identify the operating scenarios that will be modeled to assess the combined air impact.

Section 5.6 and 5.6.1 Startups/Shutdowns

21) Startup and Shutdown events need to be based on the combined operation of both power plants. The combined startup/shutdown operation of both power plants are not presented in this proposal. Any discussion of the 1-hr NO_2 modeling exemption due to transient events must refer to the combined operations of both power plants. Revise any reference to the "transient events" from individual facilities to ensure that the combined operation is being discussed.

22) Tables 5-1, 5-2, and 5-3. Remove the secondary "Type of Start-up or Shutdown Event" table from the page. Create one table presenting the numbers for the types of startup and shutdown events at Woodbridge Energy Center, Keasbey Energy Center, and the combined operations for both Keasbey and Woodbridge Energy Centers. For Woodbridge Energy center, present the permitted numbers for the conventional and rapid-response modes individually. Refer to the combined operations from this table when discussing the modeling and modeling exemptions related to the startup and shutdown operations for the facility.

23) For table 5-3. Add a footnote explaining why the Cold Start -Lead CTG has an elapsed time of 3.08 hours and a NO_x emission rate of 112 lb/hr yet the NO_x emission is only 187 lbs/event.

24) Modeling analysis for the startup and shutdown conditions will need to evaluate emissions of all criteria pollutants with a 3-hr or less averaging time for NAAQS and all startup types (warm, hot, cold) for natural gas operations. This includes SO_2 emissions. Although fuel flow will be reduced during startups, impacts may be higher given the reduced stack flow and stack temperature.

25) The discussion states "For annual averaging periods, start-ups will only be included in the modeling analysis if the potential to emit for the facility increases due to the inclusion of start-ups into the annual potential to emit calculation". Please provide how annual emissions are calculated for each piece of equipment and all criteria pollutants.

26) For startup/shutdown durations that are shorter than the averaging periods modeled at Woodbridge Energy Center, the additional prorated time should be based on the revised load analysis, not necessarily operating scenario Case 7. See comment #1.

Section 5.7 1-hour NO2 Modeling

27) The protocol should provide more information regarding how the 1 hour NO_2 modeling will be undertaken. With the promulgation of Appendix W on December 20, 2016, ARM was replaced by ARM2 for the 1 hour NO_2 Tier II modeling.

28) Is it Woodbridge and Keasbey's intention to have the emergency generators and the emergency fire pumps have a cumulative restriction of 100 hours per year for each category as described in the NJDEP July 29,2011 policy memorandum guidance?

5.11 NAAQS/NJAAQS Analysis

29) Please confirm in the text that NAAQS/NJAAQS will be evaluated by showing that the impacts plus the ambient background are less than the NAAQS/NJAAQS values for applicable averaging periods, even if the impacts are less than the SIL.

5.15.4 Impacts on Class I Areas

30) While the AQRV still needs to be resolved with FLM, Class I increment may have to be considered since the source is only 108 km in distance from the Class I area at the Brigantine Division of the Edwin B. Forsythe National Wildlife Refuge.

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March 2, 2017
mk006-17

Ms. Jennifer Levy
New Jersey Department of Environmental Protection
Division of Air Quality, Bureau of Evaluation and Planning
401 East State Street, 2nd Floor
Trenton, New Jersey 08625

Subject: **CPV Keasbey, LLC**
Keasbey Energy Center
Proposed Combined Cycle Power Facility
Township of Woodbridge, Middlesex County, New Jersey
Response to Comments on the Air Quality Modeling Protocol

Dear Ms. Levy:

In response to the Bureau of Evaluation and Planning's comment response letter issued by you on January 25, 2017 relative to the proposed CPV Keasbey, LLC's Keasbey Energy Center Revised Air Quality Modeling Protocol, please find below responses to questions/comments that were made. For ease of reference, each comment/question from your January 25, 2017 comment letter has been restated in bold with a response to the comment/question following. Also, per your request, please find attached a revised Air Quality Modeling Protocol that addresses the Bureau's comments and incorporates the responses below.

General Comments

Q1. CPV Keasbey needs to submit a site survey in accordance with the requirements set out in N.J.S.A. 45:8 et seq., N.J.A.C. 13:40-1.1 et seq., and the Bureau's Technical Manual 1002. The survey should clearly show the location of all emission points to be modeled, building structures, elevations at the facility, drawn to scale, not reduced, and indicating true north. This plot plan should include the Woodbridge Energy center and the Keasbey Energy Center.

A1. A general arrangement site plan that fulfills the requirements set out in the Bureau's Technical Manual 1002 is included as Figure 3-1. At the Department's request, this general arrangement site plan includes both the proposed Keasbey Energy Center and the existing Woodbridge Energy Center.

Q2. All maps should clearly identify the Keasbey and Woodbridge Energy Centers and should present the ambient air boundary around the combined facility.

A2. Figures 2-1 and 2-2 clearly identify the proposed location of the Keasbey Energy Center and the existing location of the Woodbridge Energy Center. Figures 2-1 and 2-2 also present the ambient air boundary around the combined facility.

Section 1.0 Introduction

Q1. Modeling for Woodbridge Energy Center cannot be based on the previous modeling from 2012. Modeling must be completed using the current version of AERMOD (version 16216), the current version of AERMET (version 16216), and the current meteorological dataset (2010-2014). All permitted operating scenarios must be evaluated for Woodbridge Energy Center.

A1. This revision has been made and is reflected in the revised protocol on page 1-2. Modeling for Woodbridge Energy Center will be completed using the current version of AERMOD (16216r) (see Section 5.1), with the current meteorological dataset (2010-2014) processed by the Department using AERMET (16216) (see Section 5.3), and provided by the Department for use on this project on February 15, 2017.

Q2. Add NO_x to the pollutant list subject to PSD permitting.

A2. This revision has been made and is reflected in the revised protocol on page 1-1.

Q3. Provide clarification to the statement that NOx modeling is required due to NOx being an ozone precursor on page 1-2. NOx has to be modeled because it is above PSD Significant Emission Rates.

A3. This revision has been made and is reflected in the revised protocol on page 1-2.

Section 2.0 Introduction

Q4. For figure 2-1, show the location of Woodbridge Energy Center.

A4. This revision has been made and is reflected on Figure 2-1.

Q5. For figure 2-2, identify the location of Woodbridge Energy Center and add a legend to clarify what the red regions represent.

A5. This revision has been made and is reflected on Figure 2-2. The red regions denote developed areas of medium intensity (i.e., single family housing units) and high intensity (i.e., apartments, row houses, and commercial/industrial).

Section 3.2 Fuels

Q6. Provide a description of the fuel types used at Woodbridge Energy Center. In this section and the previous section, please provide more details for Woodbridge Energy Center.

A6. This revision has been made and is reflected in Sections 3.1 and 3.2, respectively.

Section 3.3 Operation

Q7. Provide details on the operation restrictions for Woodbridge Energy Center, similar to the description for the Keasbey Energy Center.

A7. This revision has been made and is reflected in Sections 3.3.

Section 3.5.1 Exhaust and Emission parameters (Woodbridge Energy Center)

Q8. Provide details on all operating scenarios to be evaluated for Woodbridge Energy Center and comment on the operating scenarios from each of the power plants that may operate concurrently. See comment #1.

A8. This revision has been made and is reflected in Sections 3.5.1 and 3.5.2. Any and all operating scenarios at the proposed Keasbey Energy Center can operate concurrently with any and all operating scenarios at the Woodbridge Energy Center.

Q9. Add a section to the protocol describing how the operating scenarios from both Keasbey Energy Center and Woodbridge Energy Center will be selected for the combined modeling of both facilities.

A9. This revision has been made and is reflected in Sections 3.5.2.

Q10. For figure 3-1, include Woodbridge Energy Facility on the map.

A10. This revision has been made and is reflected on Figure 3-1.

Q11. Replace tables 3-7 and 3-8 with tables similar to 3-1a, 3-1b, and 3-2 to detail the load analysis for Woodbridge Energy Center.

A11. Tables 3-7 and 3-8 have been revised accordingly for the existing Woodbridge Energy Center.

Section 3.6 GEP Analysis

Q12. Provide a table identifying all buildings on and off site with the potential to cause aerodynamic downwash of emissions from the Keasbey and Woodbridge stacks. This analysis need only consider buildings within 0.8 kilometer or 5 L from the stack, whichever is lesser. For each stack, a table shall be provided with the following data for each building (or tier):

- **a. Building height (relative to stack base elevation);**
- **b. Maximum projected building width;**
- **c. Distance from the stack;**
- **d. SL distance; and**
- **e. Calculated formula GEP stack height.**

A12. This revision has been made and is reflected in Section 3.6 and Tables 3-12 and 3-13, respectively.

4.1.2 Prevention of Significant Deterioration

Q13. The text states that if the modeled concentrations are less than the SILs, then NAAQS and increments analyses are not required. Due to a court decision in 2013, this is not a blanket conclusion. More recent EPA guidance, such as the May 2014 PM2.5 guidance is recommended for other pollutants as well. It states that the applicant and reviewing agencies examine existing conditions to ensure that a NAAQS or increment could not be exceeded even with de minimis impacts. Even recent draft guidance for O3/PM2.5 SILs reiterates that SILs are discretionary especially in areas with significant growth (August 18, 2016). Compliance with PM2.5 increment will need to be addressed.

Update the text to reflect the current EPA guidance and provide a discussion to support your argument that NAAQS and increment could not be exceeded even with de minimis impacts. The information in Table 5-5 can be used to support the NAAQS argument but does not address the increment.

A13. This revision has been made and is reflected in Section 4.1.2.

Table 4-2a

Q14. The 8-hour ozone NAAQS value is incorrect. Revise it to reflect the 0.07 ppm standard.

A14. This revision has been made (137.2 ug/m^3) and is reflected in Table 4-2a.

Q15. Typo in footnote "d": The 24-hour PM2.5 NAAQS is a 3 year average of the 98th percentile.

A15. This revision has been made and is reflected in Table 4-2a.

Q16. Footnote "h: the modeled concentration should be conservatively estimate from the maximum 24-hour concentration. Please insert the word "maximum".

A16. This revision has been made and is reflected in Table 4-2a.

Q17. Please add a footnote saying that the 24-hour and annual SO2 averaging periods will be modeled for comparison to the SILs and NJAAQS.

A17. This revision has been made and is reflected in Table 4-2a.

Table 4-2c

Q18. Please include the proposed ozone SIL of 1 ppb to this table.

A18. This revision has been made (1.96 ug/m^3) and is reflected in Table 4-2c.

Section 5.5 Load Analysis

Q19. A load analysis for all permitted operating scenarios must be evaluated for Woodbridge Energy Center as well as Keasbey Energy Center. Provide details for the operating scenarios that will be evaluated for the Woodbridge Energy Center. See comment #1.

A19. This revision has been made and is reflected in Section 5.5.

Q20. The "worst-case" loads for Keasbey and Woodbridge Energy centers may not produce the "worst-case" scenario for their combined operation. Assessment of air quality standards must be based on the combined "worst-case" operations of the facilities.

When presenting the modeling results, provide a matrix showing the worst case air concentrations for each pollutant, averaging time, and operating scenario for both facilities. This should include continuous operations and startup/shutdown scenarios. If scenarios operate for 3 hours or less, then they do not need to be evaluated for longer averaging times (ex. Startup and Shutdown). The results should be used to determine the operating scenarios from each of the power plants that will be modeled concurrently to identify the "worst-case" combined operation. The results for the individual operating scenarios should be discussed with BEP to identify the operating scenarios that will be modeled to assess the combined air impact.

A20. As discussed with the Department, the modeling analysis will model each operating case for both Keasbey and Woodbridge Energy centers emission units and develop source groups that individually and collectively identify the worst case air quality concentrations. Likewise, summary tables will be prepared presenting these concentrations, both for each energy center sources, individually and collectively, to demonstrate compliance with the PSD increment and ambient air quality standards. This methodology is discussed in Section 5.5.

Section 5.6 and 5.6.1 Startups/Shutdowns

Q21. Startup and Shutdown events need to be based on the combined operation of both power plants. The combined startup/shutdown operation of both power plants are not presented in this proposal. Any discussion of the 1-hr NO2 modeling exemption due to transient events must refer to the combined operations of both power plants. Revise any reference to the "transient events" from individual facilities to ensure that the combined operation is being discussed.

A21. This revision has been made and is reflected in Section 5.6.2.

Q22. Tables 5-1, 5-2, and 5-3. Remove the secondary "Type of Start-up or Shutdown Event" table from the page. Create one table presenting the numbers for the types of startup and shutdown events at Woodbridge Energy Center, Keasbey Energy Center, and the combined operations for both Keasbey and Woodbridge Energy Centers. For Woodbridge Energy center, present the permitted numbers for the conventional and rapid-response modes individually. Refer to the combined operations from this table when discussing the modeling and modeling exemptions related to the startup and shutdown operations for the facility.

A22. Permitted startup and shutdown emissions and associated stack parameters for the existing Woodbridge Energy Center are shown in Table 5-3. The combined startups and shutdowns at Keasbey and Woodbridge are discussed in Section 5.6.2. Tables 5-1 and 5-2 have not been revised because it needs to be understood (from a modeling perspective) how Keasbey is proposing to startup and shutdown on both natural gas and ULSD, and that this will have no impact on how Woodbridge is currently permitted to startup and shutdown, as seen in Table 5-3. Woodbridge Energy Center's existing permit does not place limits on the number or types of startups and shutdowns that can occur.

Q23. For table 5-3. Add a footnote explaining why the Cold Start -Lead CTG has an elapsed time of 3.08 hours and a NOx emission rate of 112 lb/hr yet the NOx emission is only 187 lbs/event.

A23. Note that the 3.08 hours should actually be 3.4 hours, consistent with the existing permit. This revision has been made and is reflected in in Table 5-3. During the 3.4 hours allotted for the startup event per the permit, the permitted NO_x emission limit is 112 lb/hr.

Q24. Modeling analysis for the startup and shutdown conditions will need to evaluate emissions of all criteria pollutants with a 3-hr or less averaging time for NAAQS and all startup types (warm, hot, cold) for natural gas operations. This includes SO2 emissions. Although fuel flow will be reduced during startups, impacts may be higher given the reduced stack flow and stack temperature.

A24. Per the Department's request, 1-hour and 3-hour SO_2 concentrations will be modeled for all startup and shutdown types. These revisions have been made and are reflected in Sections 5.6, 5.6.1, and 5.6.2.

Q25. The discussion states "For annual averaging periods, start-ups will only be included in the modeling analysis if the potential to emit for the facility increases due to the inclusion of start-ups into the annual potential to emit calculation". Please provide how annual emissions are calculated for each piece of equipment and all criteria pollutants.

A25. Please refer to the emission calculations in Appendix B of the Technical Support Document that were provided to Aliya Khan of the Bureau of Stationary Sources for each piece of equipment and all criteria pollutants.

Q26. For startup/shutdown durations that are shorter than the averaging periods modeled at Woodbridge Energy Center, the additional prorated time should be based on the revised load analysis, not necessarily operating scenario Case 7. See comment # 1.

A26. For startup/shutdown durations that are shorter than the averaging periods modeled at Woodbridge Energy Center, the additional prorated time will be based on the revised load analysis. This revision has been made and is reflected in Section 5.6.1.

Section 5.7 1-hour NO2 Modeling

Q27. The protocol should provide more information regarding how the 1 hour NO2 modeling will be undertaken. With the promulgation of Appendix W on December 20, 2016, ARM was replaced by ARM2 for the 1 hour NO2 Tier II modeling.

A27. This revision has been made and is reflected in Section 5.7.

Q28. Is it Woodbridge and Keasbey's intention to have the emergency generators and the emergency fire pumps have a cumulative restriction of 100 hours per year for each category as described in the NJDEP July 29,2011 policy memorandum guidance?

A28. The existing emergency diesel generator and emergency diesel fire pump at the Woodbridge Energy Center are each permitted to operate up to 100 hours per year. These permit conditions will remain the same. For the proposed emergency diesel generator and emergency diesel fire pump at the Keasbey Energy Center, CPV is proposing to operate each unit up to 100 hours per year, the same conditions that exist for the emergency diesel generator and emergency diesel fire pump at the Woodbridge Energy Center. CPV does not intend to have a cumulative restriction of 100 hours per year applied. CPV has already agreed to the permit conditions contained in the aforementioned policy memorandum for the emergency diesel fire pump and emergency diesel generator at the existing Woodbridge Energy Center and proposes to agree to the same conditions for the emergency diesel generator and emergency diesel fire pump at the proposed Keasbey Energy Center.

The emergency diesel generators and emergency diesel fire pumps are not expected to be tested more than once per week (with test durations limited by permit condition to no more than 30 minutes) and are not expected to contribute significantly to the annual distribution of maximum 1-hour concentrations. Therefore, it is proposed that 1-hour NO_2 modeling will not include the emergency diesel generators and emergency diesel fire pumps. Further, the emergency diesel generators and emergency diesel fire pumps will not be included in the 1-hour

NO_2 and SO_2 modeling analyses, per the exemption as defined in the July 29, 2011 policy memorandum issued by NJDEP exemption emergency generator and fire pump NO_x and SO_2 emissions from 1-hour NO_2 and SO_2 air quality modeling at combined cycle turbine facilities. This response is incorporated in Section 5.7.

Section 5.11 NAAQS/NJAAQS

Q29. Please confirm in the text that NAAQS/NJAAQS will be evaluated by showing that the impacts plus the ambient background are less than the NAAQS/NJAAQS values for applicable averaging periods, even if the impacts are less than the SIL.

A29. This revision has been made and is reflected in Section 5.11.

5.15.4 Impacts on Class I Areas

Q30. While the AQRV still needs to be resolved with FLM, Class I increment may have to be considered since the source is only 108 km in distance from the Class I area at the Brigantine Division of the Edwin B. Forsythe National Wildlife Refuge.

A30. This revision has been made and is reflected in Section 5.15.4. The protocol states that Class I increment will be examined.

Please feel free to contact me at 201-508-6954 or Ted Main at 201-508-6960 should you have any additional questions. We look forward to continuing to work with you on this project.

Sincerely,

TRC

Michael D. Keller

Michael D. Keller
Principal – Power Generation and Air Quality

Attachment

cc: G. John, NJDEP
A. Colecchia, U.S. EPA Region II
J. Donovan, CPV
A. Urquhart, CPV
T. Main, TRC
TRC Project File 252973

mk006-17.ltr.doc

CHRIS CHRISTIE
Governor

KIM GUADAGNO
Lt. Governor

DEPARTMENT OF ENVIRONMENTAL PROTECTION
AIR QUALITY, ENERGY AND SUSTAINABILITY
DIVISION OF AIR QUALITY
P.O. Box 420 Mailcode 401-02
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609 - 984 - 1484

BOB MARTIN
Commissioner

MEMORANDUM

TO: Aliya Khan, Bureau of Stationary Sources

JL

FROM: Jennifer Levy, Bureau of Evaluation and Planning

DATE: March 28, 2017

SUBJECT: CPV Keasbey, LLC
Air Quality Modeling Protocol dated August 2016
(revised March 2017)
Woodbridge, Middlesex County, New Jersey
PI# 55824 BOP Application Number 160004

CPV Keasbey, LLC is proposing to construct and operate a new 630 MW combined cycle unit, identified as Keasbey Energy Center, directly adjacent to the 725 MW Woodbridge Energy Center, in Woodbridge, Middlesex County, New Jersey. The Keasbey Energy Center will consist of one dual fuel (natural gas or ultra-low sulfur diesel oil) General Electric 7HA.02 combustion turbine, one heat recovery steam generator, one natural gas-fired auxiliary boiler, one emergency diesel generator, one emergency diesel fire pump, a steam turbine generator, and a wet mechanical draft cooling tower. Control devices include dry low-NOx combustors, water injection, selective catalytic reduction (SRC), and oxidation catalyst.

The proposed project will be subject to PSD review for Greenhouse Gases (GHG), nitrogen oxides (NO_x), particulate matter less than 10 microns (PM_{10}), particulate matter less than 2.5 microns ($PM_{2.5}$), carbon monoxide (CO), sulfuric acid mist (H_2SO_4), and sulfur dioxide (SO_2). The project will be subject to non- attainment new source review for NO_x and volatile organic compounds (VOC).

The Bureau of Evaluation and Planning (BEP) in collaboration with EPA Region II has completed its review of the above referenced document. BEP is granting a conditional approval to conduct the air quality dispersion modeling. The conditional approval is dependent on fully addressing the attached comments. If there are any questions regarding the comments, contact Jennifer Levy at (609) 633-8239.

cc:
Bachir Bouzid (BOsS)
Danny Wong (BEP)
Joel Leon (BEP)
Greg John (BEP)
Annamaria Colecchia (EPA- emailed)
Ted Main (TRC)
Michael Keller (TRC)

Bureau of Evaluation and Planning Comments on the CPV Keasbey, LLC Air Quality Modeling Protocol, Dated August, 2016 (Revised March 2017)

General comments

1) CPV Keasbey needs to submit a site survey **with a raised seal** in accordance with the requirements set out in N.J.S.A. 45:8 et seq., N.J.A.C. 13:40-1.1 et seq., and the Bureau's Technical Manual 1002. The survey should include the Woodbridge Energy Center and the Keasbey Energy Center.

2) Please note that the results from the load analysis for all operating scenarios should be discussed with BEP prior to modeling the combined impact. BEP will provide guidance on the scenarios that need to be evaluated for the combined impact assessment. Additionally, the results from the load analysis for all operating scenarios should be presented in the modeling results document.

Section 3.2 Fuels

3) Should the natural gas sulfur content change in subsequent permitting decisions, the modeling must reflect the updated sulfur content.

Section 3.5 Exhaust Stack Configuration and Emission Parameters (Keasbey Energy Center)

4) The text refers to the site plan as a "general arrangement site plan" and the emission rates as "preliminary potential emission rates". This terminology suggests that the building arrangement and emission rates may be subject to change. Please note that if the information presented in this document changes, the modeling analysis will need to reflect the changes.

5) The Department recognizes that operation of the emergency generators and fire pumps will meet the modeling exemption defined in the July 29, 2011 policy memorandum. However, since the air modeling quality evaluation is for a PSD Permit, the impact evaluation must demonstrate compliance with the 1-hour NO_2 and 1-hour SO_2 National Air Quality Standards incorporating guidance outlined in the March 1, 2011 U.S. EPA Memorandum titled, *Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO2 National Ambient Air Quality Standard*.

Section 3.5.2 Combined Modeling of Keasbey Energy Center and Woodbridge Energy Center

6) Refer to general comment 2.

7) Refer to comment 4.

Section 3.6 GEP Analysis

8) BEP is providing a conditional approval to begin modeling, with the condition that additional information must be provided. For example, tables 3-12 and 3-13 create tiered structures for the HRSG while the plot plan does not list this information. Additionally, there are several buildings for Keasbey Energy Center that are not identified on the plot plan and not included in the GEP analysis. The revised plot plan (per comment 1) must include and label all structures and the downwash analysis must be revised to reflect these buildings.

Table 4-2a

9) Typo in footnote "d": It should be noted that the design value for the 24-hour averaging period is based on the 3-year average of the 24-hr 98^{th} percentile.

Section 5.6 and 5.6.2 Startups/Shutdowns

10) All short-term averaging time air quality standards (1-hr, 3-hr, 8-hr, 24-hr) must be modeled for startup and shutdown events.

11) The 1-hr NO_2 modeling exemption due to transient events must refer to the combined operations of both power plants. The request to exempt 1-hr NO_2 modeling for cold gas fired rapid starts and for cold ULSD fired rapid starts is based only on Keasbey's operations, and, therefore does not apply to the combined facility. Since Woodbridge does not have ULSD operation, the 1-hr NO_2 modeling can be considered transient for the facility. However, the 1-hr NO_2 natural gas fired cold startups at Keasbey must be included in the combined facility modeling.

12) If there are no permit limits for Woodbridge startups and shutdowns, the annual modeling must assume continuous startup emissions and stack parameters. For example, previous modeling for Woodbridge assumed 10 cold starts, 200 hot starts, and 52 warm starts.

13) Startup emissions must be included in the annual averaging modeling for all relevant criteria pollutants.

14) Add a section to the protocol providing details for how annual emissions are calculated for all relevant criteria pollutants. Note that all supporting calculations pertaining to the modeling analysis must be included in the modeling protocol. Additionally, the statement, "For annual averaging periods, start-ups will only be included in the modeling analysis if the potential to emit for the facility increases due to the inclusion of start-ups into the annual potential to emit calculation" is not valid. The annual potential to emit calculation must include startups and shutdown emissions.

Section 5.7 1-hour NO2 Modeling

15) See comment 4.

Section 5.8 NJDEP Air Toxics Risk Analysis

16) A table containing all HAPs, their emission rates, the source, the reference concentrations, and the unit risk factors must be provided. Additionally, a table containing the cancer risk, short term non-cancer risk and long term non-cancer risk results from the facility should be provided in the modeling results document. Should the maximum modeled short or long term risk exceed the threshold value for any pollutant, a map depicting all areas exceeding the threshold should be provided to show the spatial and quantitative extent of the impact.

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March 30, 2017

Mr. Greg John
New Jersey Department of Environmental Protection
Division of Air Quality, Bureau of Technical Services
401 East State Street, 2nd Floor
Trenton, New Jersey 08625

Subject: **CPV Keasbey, LLC**
Keasbey Energy Center
Proposed Combined Cycle Power Facility
Township of Woodbridge, Middlesex County, New Jersey
Revised Request for Waiver from Pre-Construction Ambient Air Quality Monitoring

Dear Mr. John:

This letter is in response to U.S. EPA Region II's comment letter issued by Steven Riva on July 26, 2016 regarding the July 12, 2016 request for waiver from preconstruction ambient air quality monitoring for the CPV Keasbey, LLC proposed combined cycle power facility (to be known as the Keasbey Energy Center) to be located in the Township of Woodbridge, Middlesex County, New Jersey (see Figure 1) in accordance with Prevention of Significant Deterioration (PSD) of Air Quality regulations.

The Keasbey Energy Center will represent a significant modification of the Woodbridge Energy Center. Since the Keasbey Energy Center, as a significant modification will potentially emit more than the Significant Emission Rates (SERs) of several air pollutants, it is subject to PSD permitting. These regulations state that major new or modified facilities having annual emissions of regulated air contaminants in excess of significant emission rates (SER) must provide an analysis of air quality data in the area of the proposed facility that, in general, consist of continuous air quality monitoring data gathered over a year preceding receipt of the application. As fully described below, this request is for a waiver from the pre-application ambient monitoring data requirement for the air contaminants: carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2) particulate matter with an aerodynamic diameter less than 10 micrometers (μm) (PM-10), and less than 2.5 micrometers (PM-2.5).

Pursuant to the PSD regulations codified in 40 CFR 52.21, and in accordance with U.S. EPA guidance "Ambient Monitoring Guidelines for PSD" (EPA-450/4-87-007) and elsewhere, the PSD pre-construction monitoring requirement may be satisfied with existing monitoring data if these data can be shown to be representative of air quality in the area of the proposed facility.

CPV Keasbey is also requesting an exemption from the pre-application ambient monitoring requirement for lead (Pb) because it will be emitted in amounts less than its SER; for fluorides, hydrogen sulfide, total reduced sulfur, and reduced sulfur compounds because they are not anticipated as a product of natural gas combustion (i.e., from the combustion turbine and auxiliary boiler) and fuel oil combustion (i.e., from the combustion turbine, emergency diesel generator, and emergency diesel fire pump); and for sulfuric acid (H_2SO_4) mist because there is no approved monitoring technique available.

Project Description

CPV Keasbey, LLC is proposing to construct a nominal 630-megawatt (MW) 1-on-1 combined cycle power facility (to be known as the Keasbey Energy Center) on a parcel of land directly adjacent the existing Woodbridge Energy Center in the Township of Woodbridge, Middlesex County, New Jersey. The combustion turbine will be primarily fueled by natural gas but will be capable of firing ultra-low sulfur diesel (ULSD) for up to 720 hours per year.

The Keasbey Energy Center will consist of one (1) General Electric (GE) 7HA.02 combustion turbine at the proposed facility site. Hot exhaust gases from the combustion turbine will flow into one (1) heat recovery steam generator (HRSG). The HRSG will produce steam to be used in the steam turbine and will be equipped with a natural gas fired duct burner. Upon leaving the HRSG, the turbine exhaust gases will be directed to one (1) exhaust stack. Other ancillary equipment at the proposed facility will include one (1) gas fired auxiliary boiler, one (1) emergency diesel fire pump, one (1) emergency diesel generator, and a wet mechanical draft cooling tower.

Emissions from the combined cycle unit will be controlled by the use of dry low-NO_x burner technology (during natural gas firing), water injection (during ULSD firing), and selective catalytic reduction (SCR) for NO_x control, an oxidation catalyst for CO and volatile organic compounds (VOCs) control, and the use of clean low-sulfur fuels (i.e., natural gas and ULSD) to minimize emissions of SO_2, PM/PM-10/PM-2.5, and H_2SO_4. Exhaust gases from the combined cycle unit after emission controls will be dispersed to the atmosphere via one (1) stack. Steam from the steam turbine will be sent to a condenser where it will be cooled to a liquid state and returned to the HRSG. Waste heat from the condenser will be dissipated through a wet mechanical draft cooling tower.

Facility Emissions

The proposed facility (as a significant modification to a major source) is located in an attainment area for SO_2, NO_2, CO, PM-10, and PM-2.5. The proposed facility will potentially emit more than the SERs for several air pollutants, and will be subject to PSD permitting for these constituents. Under PSD regulations, an air quality dispersion modeling analysis is required to ensure that CO, PM-10, PM-2.5, SO_2, and NO_2 emissions from the proposed facility will be compliant with NAAQS and applicable PSD Class II increments.

Table 1 presents projected facility emission rates and the pollutant specific significant emission rates (SERs) defined in the PSD regulations. The proposed facility is projected to have annual emissions in excess of PSD SERs for CO, NO_2, SO_2, particulates (PM/PM-10/PM-2.5), and H_2SO4. The emissions of lead are below its SER.

Existing Background Ambient Air Quality Data

Based on a review of the locations of NJDEP ambient air quality monitoring sites, the closest "regional" NJDEP monitoring sites will be used to represent the current background air quality in the site area. These monitors have been designed, sited, and operated in accordance with U.S. EPA monitoring guidelines in terms of quality assurance and quality control of the data collection and the reliability of the data itself which are outlined at the EPA's Report on the Environment website https://cfpub.epa.gov/roe/technical-documentation.cfm. This website documents the QA/QC components of the data collection process as follows:

> ***9. Quality Assurance and Quality Control***
>
> *The quality assurance/quality control (QA/QC) of the national air monitoring program has several major components: (1) the data quality objective (DQO) process; (2) reference and equivalent methods program; (3) EPA's National Performance Audit Program (NPAP); (4) system audits; and (5) network reviews (http://www.epa.gov/ttn/amtic/netamap.html). To ensure quality data, the SLAMS are also required to meet the following QA/QC criteria: (1) each site must meet network design and site criteria; (2) each site must provide adequate QA assessment, control, and corrective action functions according to minimum program requirements; (3) acceptable data validation and record keeping procedures must be followed; and (4) data from SLAMS must be reported annually to EPA. Finally, there are system audits that regularly review the overall air quality data collection activity for any needed changes or corrections.*

Background data for CO and SO_2 was obtained from a New Jersey monitoring station located in Union County (EPA AIRData #34-039-0004). The monitor is located at Interchange 13 on the New Jersey Turnpike (Elizabeth Lab), approximately 17 km northeast of the proposed facility. This monitor is located in an area with a greater amount of mobile and point sources of air emissions as compared to the project area. Thus, this monitor would be considered to conservatively represent the ambient air quality within the project area.

Background data for PM-10 was obtained from a Jersey City monitoring station located in Hudson County, New Jersey (EPA AIRData # 34-017-1003), approximately 32 km northeast of the proposed facility. The monitor is located at 355 Newark Avenue in a commercial/urban area. This monitor is located in an area with a greater amount of mobile and point sources of air emissions as compared to the project area. Thus, this monitor would be considered to conservatively represent the ambient air quality within the project area.

Background data for NO_2 was obtained from an East Brunswick monitoring station located in Middlesex County, New Jersey (EPA AIRData # 34-023-0011), approximately 11 km west-southwest of the proposed facility. The monitor is located at Rutgers University (Veg. Research Farm #3 on Ryders Lane) in an agricultural/rural area with proximate commercial uses (i.e., Route 1 and Interstate 95). This monitor's close proximity to the Project site would qualify it to be representative of the ambient air quality within the project area.

Background data for PM-2.5 was obtained from a New Brunswick Township monitoring station located in Middlesex County, New Jersey (EPA AIRData # 34-023-0006), approximately 10 km west-southwest of the proposed facility. The monitor is located at Rutgers University's Cook College (Log Cabin Road) in an agricultural/rural area with proximate commercial uses. This monitor's close proximity would qualify it to be representative of the ambient air quality within the project area.

The monitoring data for the most recent three years (2013-2015) are presented in Table 2 while Figure 2 displays the locations of the aforementioned air quality monitors in relation to the proposed facility.

Monitoring Waiver Request

In summary, CPV Keasbey, LLC is requesting a waiver from the requirement to perform pre-application ambient air quality monitoring for CO, NO_2, SO_2, PM-10, and PM-2.5 because there exists acceptable quality assured ambient air quality data from alternate locations that satisfy the requirements of 40 CFR 52.21. Further, CPV Keasbey is requesting an exemption from the requirement to perform pre-application ambient monitoring for lead because it will be emitted in amounts less than its SER; for fluorides, hydrogen sulfide, total reduced sulfur, and reduced sulfur compounds because they are not anticipated as a product of natural gas combustion (i.e., from the combustion turbine, and auxiliary boiler) and fuel oil combustion (i.e., from the combustion turbine, emergency diesel generator, and emergency diesel fire pump); and for H_2SO_4 because there is no approved monitoring technique available.

Please feel free to contact me (201) 508-6960 or tmain@trcsolutions.com should you have any questions regarding this monitoring exemption request.

Sincerely,

TRC

Theodore Main

Theodore Main
Principal Consulting Meteorologist

cc: A. Colecchia, U.S. EPA Region II
J. Donovan, CPV
A. Urquhart, CPV
M. Keller, TRC
TRC Project File 252973

TRC

Table 1
Comparison of Projected Facility Emissions to PSD Significant Emission Rates

Pollutant	Keasbey Energy Center Projected Emission Rate (tons per year)	Significant Emission Rate (tons per year)
Carbon Monoxide	111.6	100
Sulfur Dioxide	40.8	40
Particulate Matter (PM)	72.0	25
Particulate Matter less than 10 microns (PM-10)	122.5	15
Particulate Matter less than 2.5 microns (PM-2.5)	118.3	10
Nitrogen Oxides	151.9	40
Lead	0.03	0.6
Fluorides	[a]	3
Sulfuric Acid Mist[b]	25.7	7
Hydrogen Sulfide	[a]	10
Total Reduced Sulfur (including H_2S)	[a]	10
Reduced Sulfur Compounds (including H_2S)	[a]	10

[a]Not anticipated as a product of natural gas (i.e., from the combustion turbine and auxiliary boiler) or fuel oil combustion (i.e., from the combustion turbine, emergency diesel generator, and emergency diesel fire pump), and assumed zero.

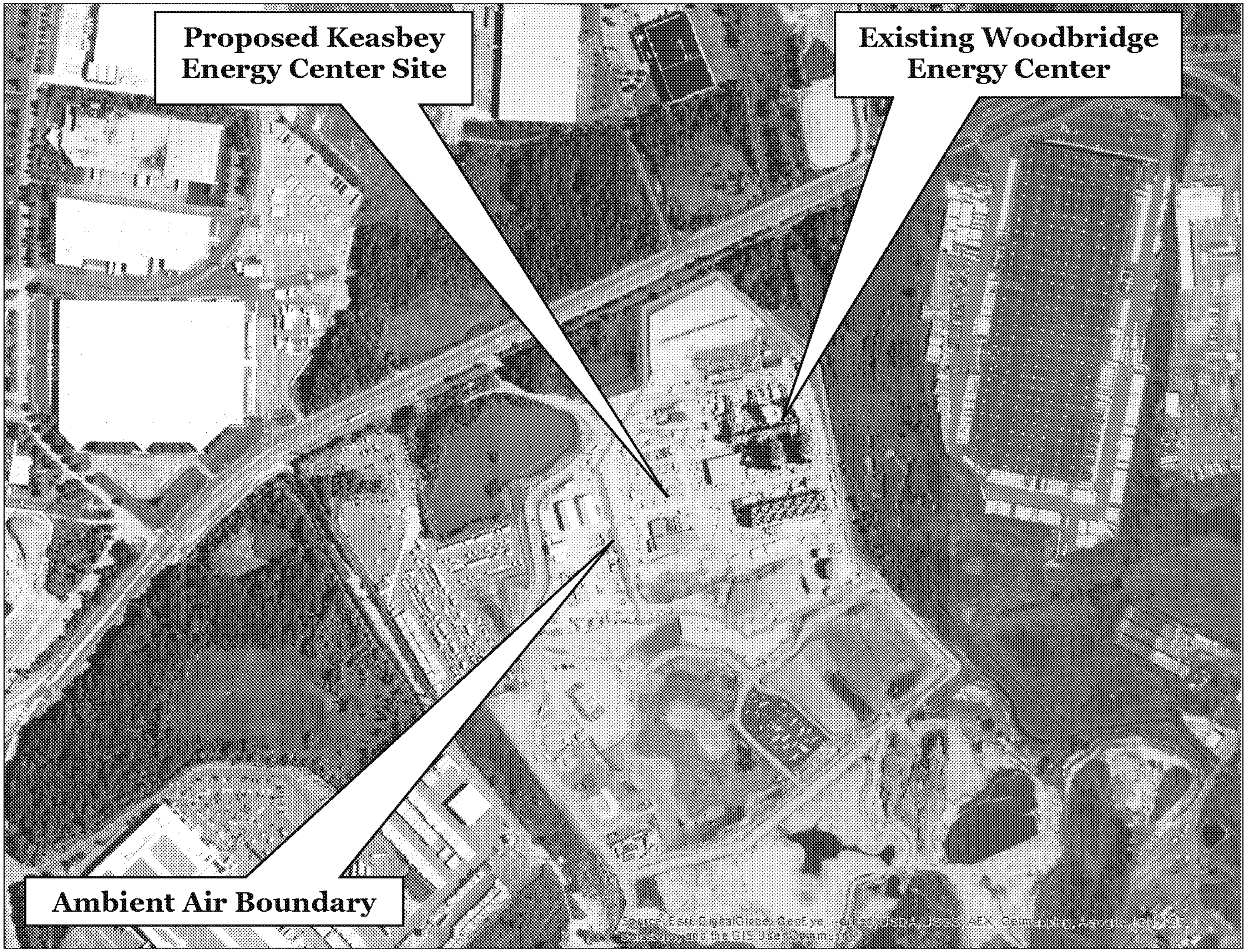
[b]No acceptable monitoring techniques exist for this pollutant.

Table 2
Ambient Concentrations of Criteria Pollutants
Proposed to be Used to Represent Site Conditions

Pollutant	Averaging Period	Maximum Ambient Concentrations ($\mu g/m^3$)		
		2013	2014	2015
SO_2	1-Hour[c]	36.7	34.1	39.3
	3-Hour	28.8	28.8	55.0
	24-Hour	15.7	13.1	11.8
	Annual	2.6	2.6	--
NO_2	1-Hour[a] Annual	75.2 18.8	88.4 16.9	90.2 19.3
CO	1-Hour 8-Hour	2,300 1,495	2,530 2,070	2,760 1,840
PM-10	24-Hour	43	37	44
PM-2.5[b]	24-Hour Annual	19.1 8.0	20 8.2	20 7.9

[a]1-hour 3-year average 98th percentile value for NO_2 is **84.91** ug/m3.
[b]24-hour 3-year average 98th percentile value for PM-2.5 is **19.7** ug/m3; Annual 3-year average value for PM-2.5 is **8.0** ug/m3.
[c]1-hour 3-year average 99th percentile value for SO_2 is **36.7** ug/m3.

High second-high short term (1-, 8-, and 24-hour) and maximum annual average concentrations presented for all pollutants other than PM-2.5 and 1-hour NO_2.
Monitored background concentrations obtained from the U.S. EPA AIRData, AirExplorer, and Air Quality System (AQS) websites.



Keasbey Energy Center
Proposed Combined Cycle Power Facility
Township of Woodbridge, Middlesex County, New Jersey

Figure 1. Site Location Aerial Photograph

Source: Esri, Digital Globe, GeoEye, 2017.

TRC

Keasbey Energy Center
Proposed Combined Cycle Power Facility
Township of Woodbridge, Middlesex County, New Jersey

Figure 2. Background Ambient Air Quality Monitors

Source: Google Earth, 2016.

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June 21, 2017
mk016-17

Ms. Annamaria Colecchia
U.S. EPA Region II – Air Programs Branch
290 Broadway – 25th Floor
New York, New York 10007-1866

Subject: CPV Keasbey, LLC Combined Cycle Power Facility
Township of Woodbridge, Middlesex County, New Jersey
Request for Use of PVMRM Method in AERMOD

Dear Ms. Colecchia:

TRC, on behalf of CPV Keasbey, LLC, prepared and submitted a Prevention of Significant Deterioration (PSD) permit application for a proposed 630-megawatt (MW) (nominal) combined cycle power facility (to be known as Keasbey Energy Center) to be constructed in the Township of Woodbridge, Middlesex County, New Jersey. The approximate Universal Transverse Mercator (UTM) coordinates of the Proposed Facility are 557,515 meters Easting, 4,485,100 meters Northing, in Zone 18, NAD83 (see Figure 1).

The Keasbey Energy Center will represent a significant modification of the Woodbridge Energy Center. Since the Keasbey Energy Center, as a major modification, will potentially emit more than the Significant Emission Rates (SERs) of several air pollutants, it is subject to PSD permitting.

The Keasbey Energy Center will consist of one (1) combustion turbine generator (General Electric (GE) 7HA.02) with a heat recovery steam generator (HRSG) equipped with a natural gas fired duct burner that will be tied to one (1) steam generator. The proposed facility will be fueled exclusively by natural gas since CPV Keasbey, LLC has decided to eliminate ultra-low sulfur diesel (ULSD) as a fuel for the combustion turbine. A dry low NO_x burner and Selective Catalytic Reduction (SCR) will be used to reduce nitrogen oxides (NO_x) emissions from the combustion turbine. The firing of natural gas in the combustion turbine will minimize emissions of particulate matter with an aerodynamic diameter less than 10 microns (PM-10), particulate matter with an aerodynamic diameter less than 2.5 microns (PM-2.5), sulfur dioxide (SO_2), and sulfuric acid mist (H_2SO_4). Additionally, an oxidation catalyst will be installed to control the emissions of carbon monoxide (CO) and volatile organic compounds (VOC).

Combustion products from the Power Island (i.e., combustion turbine/duct burner) will be discharged through one (1) exhaust stack. Supporting auxiliary equipment includes a gas fired auxiliary boiler, an emergency diesel generator, an emergency diesel fire pump, and a wet mechanical draft cooling tower.

TRC, on behalf of CPV Keasbey, LLC, is proposing to use the Plume Volume Molar Ratio Method (PVMRM), one of U.S. EPA's Tier 3 screening methods, to model NO_2 emissions. The use of PVMRM as a Tier 3 screening method requires consultation with U.S. EPA for a project triggering federal permitting requirements, which this project does.

PVMRM adjusts NO_x emissions to estimate more realistic ambient NO_2 concentrations by modeling the conversion of NO_x to NO_2. Additional information needed to use PVMRM includes the NO_2/NO_x ratio within each NO_2 emitting stack, the ambient NO_2/NO_x ratio, and background ozone concentrations.

The "Revisions to the Guideline on Air Quality Models: Enhancement to the AERMOD Dispersion Modeling System and Incorporation of Approaches to Address Ozone and Fine Particulate Matter", published final in the Federal Register on January 17, 2017, the U.S. EPA memorandum "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 NAAQS" dated March 1, 2011, and the U.S. EPA memorandum "Applicability of Appendix W Modeling Guidance for the 1-hour NO_2 NAAQS" dated June 28, 2010, provide suggested procedures for the application of the methods available in AERMOD for Tier 3 refinements, as summarized below:

- Tier 1 assumes total conversion of NO to NO_2;
- Tier 2 assumes ambient equilibrium between NO and NO_2; and,
- Tier 3 provides "detailed screening methods" that account for ambient ozone and the relative amount of NO and NO_2 emitted from the source.

For the purpose of this request, implementation of this tiered approach to demonstrate compliance with the 1-hour NO_2 NAAQS is proposed. Should the results of the Tier 1 and Tier 2 analyses indicate that further refinement of the predicted impacts are necessary, use of the PVMRM Tier 3 detailed screening option available in the AERMOD model (version 16216r) is proposed. Based on the information provided in this request, refined modeling analyses are proposed to demonstrate compliance with the 1-hour average NO_2 NAAQS.

PVMRM Input Data

PVMRM incorporates three sets of data into the calculation of 1-hour NO_2 concentrations. Those are source-specific in-stack NO_2/NO_x emission rate ratios, an ambient NO_2/NO_x concentration ratio, and hourly average background ozone concentrations.

Instead of source-specific in-stack NO_2/NO_x emission rate ratios, a value of 0.50 is proposed for input to the PVMRM option. The March 1, 2011 Fox memo[1] outlines the "general acceptance of 0.50 as a default in-stack ratio of NO_2/NO_x for input to the PVMRM and OLM options within AERMOD, in the absence of more appropriate source-specific information on in-stack ratios".

[1] Additional Clarification Regarding Applicability of Appendix W Modeling Guidance for the 1-hour NO_2 NAAQS, Tyler Fox, OAQPS, March 1, 2011.

The PVMRM option for modeling conversion of NO to NO_2 incorporates a default NO_2/NO_x ambient equilibrium ratio of 0.90. This value is proposed to be used in AERMOD.

Hourly Average Background NO_2 Concentrations

Pollutant background concentrations are required to appropriately assess the ambient air quality concentrations that may contribute to the total ambient pollutant concentrations. Background concentrations are added to model-predicted concentrations to calculate the total concentrations for comparison to the NAAQS. Criteria pollutant background concentration values are derived from ambient air quality data monitored at stations that are determined to be representative of expected background concentrations at the proposed source location and potential impact area. In order to conduct cumulative impact analyses, background values must be combined with modeled results to compare to the 1-hour NO_2 NAAQS.

Based on review of the locations of NJDEP ambient air quality monitoring sites, the closest "regional" NJDEP monitoring site will be used to represent the current background NO_2 air quality in the site area. Background data for NO_2 from 2012 – 2014 was obtained from a monitoring station located in Middlesex County, New Jersey (EPA AIRData # 34-023-0011), approximately 11 km west-southwest of the Proposed Facility (see Figure 2).

The monitor is located at the Rutgers University (Veg. Research Farm #3 on Ryders Lane) in an agricultural/rural area with proximate commercial uses (i.e., Route 1 and Interstate 95). This monitor's close proximity to the Project site would qualify it to be representative of the ambient air quality within the project area.

It should be noted that the 2013 – 2015 time period was initially examined. However, due to poor data capture in the spring and summer months of 2015, the time period of 2012 – 2014 was used instead. Seasonal data availability for NO_2 at Rutgers University from 2012 – 2014 was as follows:

- Winter: 2012 (87.9%), 2013 (98.6%), 2014 (98.6%)
- Spring: 2012 (95.2%), 2013 (96.8%), 2014 (97.4%)
- Summer: 2012 (98.8%), 2013 (98.3%), 2014 (97.5%)
- Fall: 2012 (91.8%), 2013 (98.2%), 2014 (98.4%)

The March 1, 2011 Fox memorandum provides guidance for incorporating background concentrations in the impact assessment for the 1-hour NO_2 standard.

> "We believe that an appropriate methodology for incorporating background concentrations in the cumulative impact assessment for the 1-hour NO_2 standard would be to use multiyear average of the 98^{th}-percentile of the available background concentrations by season and hour-of-day..."
>
> "...we recommend that background values by season and hour-of-day used in the context should be based on the 3^{rd} highest values for each season and hour of day combination..."

This seasonal and hour of day methodology is proposed to be used. The background values will first be divided by season for each year. Those seasonal groups will be further binned into 24-hour groups for a total of 96 bins of values (product of 4 seasons and 24 hours) for each year (2012, 2013, and 2014). The 3rd highest value from each bin will be found per year. Finally, to obtain the values to be summed with the modeled concentrations, the average of those 3rd highest values will be taken over three (3) years. This will result in 96 values being used in the modeling analysis (see Table 1). The AERMOD model option (keyword BACKGROUND) will be used to sum each modeled concentration with the background concentration that was calculated for that season and hour-of-day.

Hourly Average Background Ozone Concentrations

The determination of representative hourly average background ozone concentrations for input to AERMOD is proposed. The ozone monitors closest to the Proposed Facility site have been identified. After reviewing their locations and periods of record, a Middlesex County monitor is proposed to represent the ozone background values during the five (5) year period 2010 – 2014, concurrent with the five (5) years of surface meteorological data. This monitor is listed below and its location can be seen in Figure 2.

- Middlesex County – Rutgers University (Veg. Research Farm #3), approximately 11 km west-southwest, EPA AIRData # 34-023-0011.

Ozone data availability at the Rutgers University monitor during each of the aforementioned years is as follows:

- 2010: 96%
- 2011: 99%
- 2012: 96%
- 2013: 99%
- 2014: 98%

The Rutgers University monitor is also proposed to represent background NO_2 concentrations. Since both datasets will be used in the NO_2 air quality analysis, this monitor is preferable and appropriate to use for ozone background representation. When ozone data was missing from the Rutgers University monitor, missing hours were substituted using the monitor hierarchy below. This hierarchy favored proximity to the Proposed Facility site, high capture rate monitors, and monitors with "general/background" or "population exposure" monitoring objectives.

- Hudson County – Bayonne, approximately 22 km away, EPA AIRData # 34-017-0006.
    - Ozone data availability at the Bayonne monitor during each of the aforementioned years is as follows:
        - 2010: 96%; 2011: 97%; 2012: 81%; 2013: 55%; 2014: 98%
- Essex County – Newark Firehouse, approximately 24 km away, EPA AIRData # 34-013-0003.
    - Ozone data availability at the Newark Firehouse monitor during each of the aforementioned years is as follows:
        - 2010: 95%; 2011: 96%; 2012: 97%; 2013: 98%; 2014: 98%

- Hunterdon County – Flemington, approximately 41 km away, EPA AIRData # 34-019-0001.
    - Ozone data availability at the Flemington monitor during each of the aforementioned years is as follows:
        - 2010: 99%; 2011: 99%; 2012: 98%; 2013: 99%; 2014: 99%
- Mercer County – Rider University, approximately 45 km away, EPA AIRData # 34-021-0005.
    - Ozone data availability at the Rider University monitor during each of the aforementioned years is as follows:
        - 2010: 99%; 2011: 99%; 2012: 98%; 2013: 98%; 2014: 88%

References

Revisions to the Guideline on Air Quality Models (Revised). Enhancements to the AERMOD Dispersion Modeling System and Incorporation of Approaches to Address Ozone and Fine Particulate Matter. Appendix W to Title 40 U.S. Code of Federal Regulations (CFR) Parts 51 and 52, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency. Research Triangle Park, North Carolina. January 17, 2017.

Clarification on the Use of AERMOD Dispersion Modeling for Demonstrating Compliance with the NO_2 NAAQS, U.S. EPA, September 30, 2014.

Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard, to the Regional Air Division Directors from Tyler Fox, Leader of the EPA Air Quality Modeling Group, EPA Office of Air Quality Planning and Standards, March 1, 2011.

Applicability of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard, to the Regional Air Division Directors from Tyler Fox, Leader of the EPA Air Quality Modeling Group, EPA Office of Air Quality Planning and Standards, June 28, 2010.

We believe the information contained in this request provides appropriate justification for the use of the PVMRM method in AERMOD. Please feel free to contact me or Ted Main at 201-508-6954 or 201-508-6960, respectively, should you have any questions regarding the enclosed request.

Sincerely,

TRC

Michael D. Keller

Michael D. Keller
Principal – Power Generation and Air Quality

cc: J. Levy, NJDEP
G. John, NJDEP
A. Urquhart, CPV
T. Main, TRC
TRC Project File 252973

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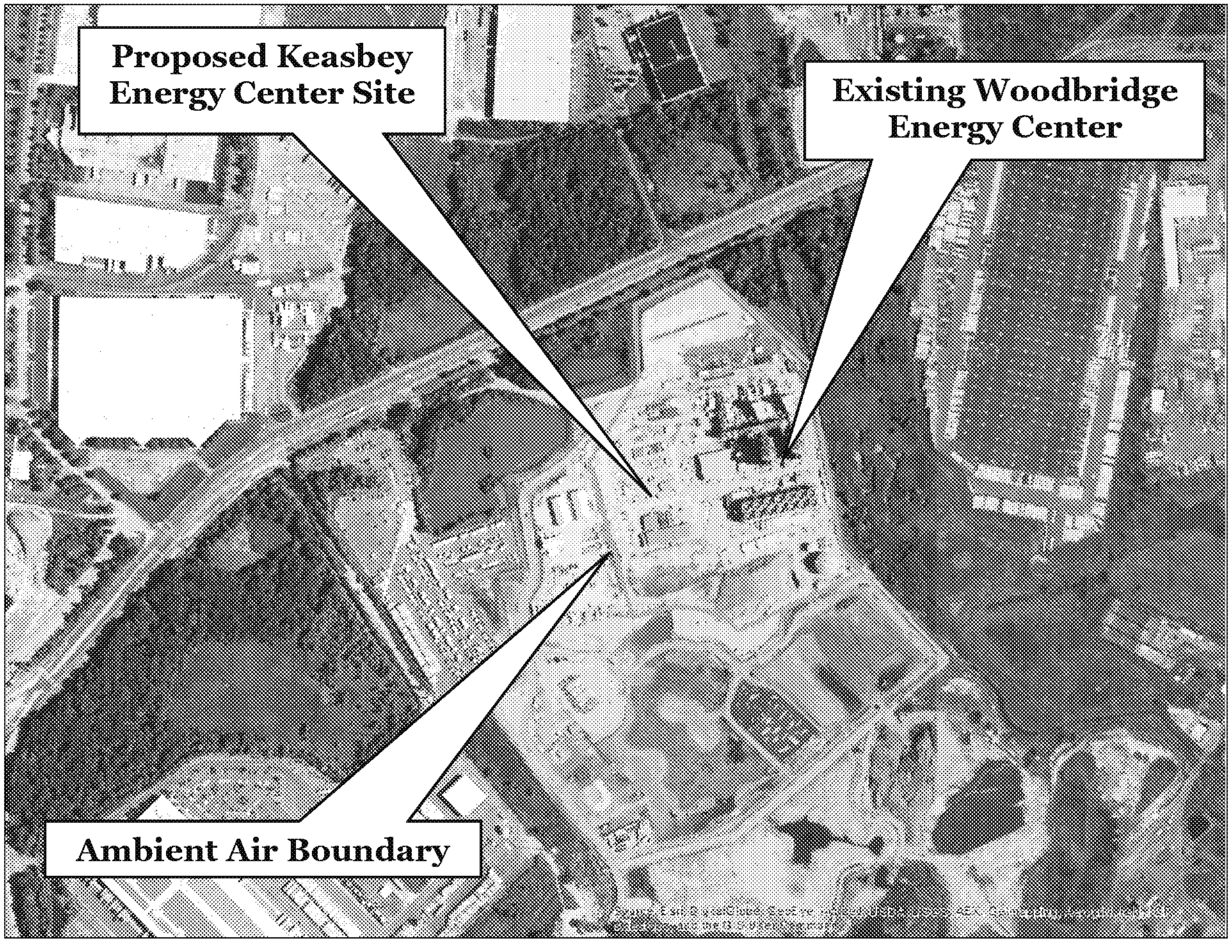
Table 1
Season and Hour of Day
Background NO_2 Concentrations
Proposed to be Used in AERMOD

Hour	Winter	Spring	Summer	Fall
1	39.0	31.7	18.0	28.0
2	38.3	31.0	15.3	29.0
3	39.0	31.3	16.3	28.3
4	38.7	30.3	17.0	26.7
5	39.7	31.0	16.3	27.3
6	38.3	33.0	17.3	26.7
7	41.0	32.3	17.7	28.0
8	42.7	35.3	20.7	27.3
9	40.7	29.0	23.3	29.3
10	41.3	25.0	19.7	27.7
11	37.7	20.7	16.7	25.0
12	36.0	17.7	15.7	23.3
13	35.7	19.3	13.0	23.3
14	34.3	17.7	11.3	23.7
15	39.7	17.3	13.0	24.0
16	37.3	16.0	12.3	24.0
17	35.3	18.3	10.0	28.0
18	36.3	20.3	10.7	33.3
19	40.3	27.0	13.0	32.0
20	39.0	29.0	13.7	32.0
21	39.7	29.0	14.3	30.7
22	39.7	29.0	14.7	30.7
23	38.7	33.0	15.7	30.3
24	40.3	30.0	16.3	29.7

Note: Concentrations are in ppb.



Keasbey Energy Center **Proposed Combined Cycle Power Facility** **Township of Woodbridge, Middlesex County, New Jersey**
Figure 1. Site Location Aerial Photograph
Source: Esri, Digital Globe, GeoEye, 2017.

Keasbey Energy Center
Proposed Combined Cycle Power Facility
Township of Woodbridge, Middlesex County, New Jersey

Figure 2. Background NO_2 and Ozone Monitor Locations

Source: Google Earth, 2017.

State of New Jersey

DEPARTMENT OF ENVIRONMENTAL PROTECTION
AIR QUALITY, ENERGY AND SUSTAINABILITY
Division of Air Quality
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CHRIS CHRISTIE
Governor

KIM GUADAGNO
Lt. Governor

BOB MARTIN
Commissioner

Michael D. Keller
TRC
1200 Wall Street West, 5th Floor
Lyndhurst, NJ 07071

July 19, 2017

SUBJECT: CPV Keasbey, LLC Combined Cycle Power Plant
Township of Woodbridge, Middlesex County
Program Interest ID 18940, BOP Application Number 16-0007

Dear Mr. Keller:

In conference with U.S. EPA Region II Air Programs Branch, the Bureau of Evaluation and Planning (BEP) has reviewed your letter, dated June 21, 2017 requesting the use of the Plume Volume Molar Ratio Method (PVMRM) in AERMOD as a Tier 3 screening method to model NO_2 emissions for the CPV Keasbey Energy Center. The use of PVMRM will assist in demonstrating compliance with the 1-hour average NO_2 National Ambient Air Quality Standard (NAAQS).

The methodology outlined in the letter includes the use of an in-stack NO_2/NOx emission ratio of 0.50, 1-hour NO_2 background data from the NJDEP's monitor station located at Rutgers University in Middlesex County (EPA AIRData #34-023-001) averaged by season and hour of day for a total of 96 different values, and hourly background ozone concentrations measured at the same Rutgers University monitoring station, as inputs to AERMOD. U.S. EPA Region II and the BEP agree with the approach described and make the following recommendations:

1. Convert the NO_2 background data in the letter's Table 1 from ppb to μg/m3 using standard conditions (i.e., 25°C, 101.325 kPa).
2. Accurately pair hourly ozone concentrations with concurrent meteorological data.
3. Provide output using both max daily (MAXDCONT) and max daily by year (MXDYBYYR) options.

Furthermore, the discussion associated with the Tier 3 screening method should provide more detail on why the 2015 monitoring data was not used, and specify how the results of the 1-hour NO_2 dispersion modeling with PVMRM is being applied (i.e., comparison with the 1-hour NO_2 Significant Impact Level (SIL) of 7.5 $\mu g/m^3$, compliance with the 1-hour NO_2 NAAQS). Finally, include how the annual NO_2 impacts will be modeled for comparison to the annual SIL, NAAQS, and Prevention of Significant Deterioration Increment.

If you have any questions, please contact me at (609) 633-1106, or Jennifer Levy at (609) 633-8239.

Sincerely,

Gregory John
Research Scientist
Bureau of Evaluation and Planning

C: Joel Leon
Jennifer Levy
Annamaria Colecchia, USEPA, Region II
Neha Sareen, USEPA, Region II
Ted Main, TRC

PM-2.5 & PM-10 Cooling Tower Particulate Fractions Based on SPX TU-12 High Efficiency Drift Eliminator*

Drop Diameter (micrometers)	Mass Fraction	Particle size after evaporation (micrometers)	volume droplet	volume particle	particle diameter	CumMass
5	0	0.6	6.54E+01	1.39E-01	0.6	0
10	0.12	1.3	5.24E+02	1.12E+00	1.3	0.12
15	0.08	1.9	1.77E+03	3.76E+00	1.9	0.2
35	0.2	4.5	2.24E+04	4.78E+01	4.5	0.4
65	0.2	8.4	1.44E+05	3.06E+02	8.4	0.6
115	0.2	14.8	7.96E+05	1.70E+03	14.8	0.8
170	0.1	21.9	2.57E+06	5.48E+03	21.9	0.9
230	0.05	29.6	6.37E+06	1.36E+04	29.6	0.95
375	0.04	48.2	2.76E+07	5.88E+04	48.2	0.99
525	0.008	67.5	7.58E+07	1.61E+05	67.5	0.998
1000	0.002	128.7	5.24E+08	1.12E+06	128.7	1

6240 ppm TDS**
2.93 g/g salt density
** Keasbey Energy Center cooling tower TDS

24% PM2.5 Mass Fraction
65% PM10 Mass Fraction

2.17 **NaCl**
2.93 **$CaCO_3$**

*Based on "Calculating Realistic PM10 Emissions from Cooling Towers"
Abstract No. 216 Session No. AM-1b
Joel Reisman and Gordon Frisbie
Greystone Environmental Consultants, Inc., 650 University Avenue, Suite 100, Sacramento, California 95825

Methodology:
1. Calculate evaporated solid particle size diameters based on TU-12 droplet distribution.
2. Determine cumulative mass distribution for all particle sizes.
3. Determine PM2.5 and PM10 cumulative mass distributions using linear interpolation between particle diameters.

Reisman, J., and Frisbie, G. 2002. Calculating Realistic PM10 Emissions from Cooling Towers. Abstract No. 216 presented at the 2001 94th Annual Air and Waste Management Association Conference and Exhibition in Orlando, Florida, June 25 to 28.

SPX Cooling Technologies

Balcke | Hamon Dry Cooling | Marley

COOLING TOWER DRIFT MASS DISTRIBUTION
TU12 Excel Drift Eliminators

The following table represents the predicted mass distribution of drift particle size for cooling tower drift dispersed from Marley TU12 Excel Drift Eliminators.

Mass in Particles (%)		Droplet Size (Microns)
0.2	Larger Than	525
1.0	Larger Than	375
5.0	Larger Than	230
10.0	Larger Than	170
20.0	Larger Than	115
40.0	Larger Than	65
60.0	Larger Than	35
80.0	Larger Than	15
88.0	Larger Than	10

How to read table: Example – 0.2% of the drift will have particle sizes larger than 525 microns.

APPENDIX H

MODELING INPUT AND OUTPUT FILES

(Not included in every copy)

APPENDIX J

MODELING RESULTS FOR KEASBEY AND WOODBRIDGE AS INDEPENDENT OPERATIONS

Keasbey Facility Maximum Modeled Concentrations Due to Normal Operations Compared to Significant Impact Levels (SILs)

Pollutant	Averaging Period	Significant Impact Concentration (μg/m³)	Maximum Modeled Concentration (μg/m³)
CO	1-Hour	2,000	377.6[c]
	8-Hour	500	77.1[c]
SO_2	1-Hour	7.8	3.9[b]
	3-Hour	25	4.0[c]
	24-Hour	5	2.6[c]
	Annual	1	0.07[c]
PM-10	24-Hour	5	8.2[c]
PM-2.5	24-Hour	1.2	5.5[e]
	Annual	0.3	0.19[d]
NO_2	1-Hour	7.5	21.1[a,b]
	Annual	1	0.50[a,c]

Note:
1-hr and 8-hr CO, 3-hr SO_2 includes CT, AB, DFP, EDG
24-hr PM-10 and PM-2.5 includes CT, AB, DFP, EDG, cooling tower
1-hr SO_2 and 1-hr NO_2 includes CT, AB, DFP, EDG
Annual NO_2 and SO_2 includes CT, AB, DFP, EDG
Annual PM-10 and PM-2.5 includes CT, AB, DFP, EDG, cooling tower

[a]Includes use of PVMRM.
[b]Based upon maximum 1st highest maximum daily 1-hour results averaged over 5-years
[c]Maximum modeled concentration.
[d]Maximum annual results averaged over 5-years.
[e]Based upon maximum 1st highest 24-hour results averaged over 5-years.

Woodbridge Facility Maximum Modeled Concentrations Due to Normal Operations Compared to Significant Impact Levels (SILs)

Pollutant	Averaging Period	Significant Impact Concentration ($\mu g/m^3$)	Maximum Modeled Concentration ($\mu g/m^3$)
CO	1-Hour	2,000	154.6[c]
	8-Hour	500	56.8[c]
SO_2	1-Hour	7.8	3.2[b]
	3-Hour	25	3.3[c]
	24-Hour	5	2.1[c]
	Annual	1	0.07[c]
PM-10	24-Hour	5	9.4[c]
PM-2.5	24-Hour	1.2	4.7[e]
	Annual	0.3	0.33[d]
NO_2	1-Hour	7.5	18.6[a,b]
	Annual	1	0.98[a,c]

Note:
1-hr and 8-hr CO, 3-hr SO_2 includes 2CTs, AB, DFP, EDG
24-hr PM-10 and PM-2.5 includes 2CTs, AB, DFP, EDG, cooling tower
1-hr SO_2 and 1-hr NO_2 includes 2CTs, AB, DFP, EDG
Annual NO_2 and SO_2 includes 2CTs, AB, DFP, EDG
Annual PM-10 and PM-2.5 includes 2CTs, AB, DFP, EDG, cooling tower

[a]Includes use of PVMRM.
[b]Based upon maximum 1st highest maximum daily 1-hour results averaged over 5-years
[c]Maximum modeled concentration.
[d]Maximum annual results averaged over 5-years.
[e]Based upon maximum 1st highest 24-hour results averaged over 5-years.

Maximum Modeled Keasbey Facility Concentrations During Startup/Shutdown Compared to Significant Impact Levels (SILs)

Pollutant	Averaging Period	Significant Impact Concentration (µg/m³)	Maximum Modeled Concentration (µg/m³)
CO	1-Hour	2,000	377.6[c]
	8-Hour	500	77.1[c]
NO_2	1-Hour	7.5	47.7[a,b]
	Annual	1	0.50[a,c]
SO_2	1-Hour	7.8	3.9[b]
	3-Hour	25	4.0[c]
	24-Hour	5	2.6[c]
	Annual	1	0.07[c]
PM-10	24-Hour	5	8.2[c]
PM-2.5	24-Hour	1.2	6.7[e]
	Annual	0.3	0.19[d]

Note:
1-hr and 8-hr CO, 3-hr SO_2 includes CT, AB, DFP, EDG
24-hr PM-10 and PM-2.5 includes CT, AB, DFP, EDG, cooling tower
1-hr SO_2 and 1-hr NO_2 includes CT, AB
Annual NO_2 and SO_2 includes CT, AB, DFP, EDG
Annual PM-10 and PM-2.5 includes CT, AB, DFP, EDG, cooling tower

[a]Includes use of PVMRM.
[b]Based upon maximum 1st highest maximum daily 1-hour results averaged over 5-years.
[c]Maximum modeled concentration.
[d]Maximum annual results averaged over 5-years.
[e]Based upon maximum 1st highest 24-hour results averaged over 5-years.

Maximum Modeled Woodbridge Facility Concentrations During Startup/Shutdown Compared to Significant Impact Levels (SILs)

Pollutant	Averaging Period	Significant Impact Concentration (μg/m3)	Maximum Modeled Concentration (μg/m3)
CO	1-Hour	2,000	1,428.5[c]
	8-Hour	500	498.4[c]
NO_2	1-Hour	7.5	72.4[a,b]
	Annual	1	0.99[a,c]
SO_2	1-Hour	7.8	5.3[b]
	3-Hour	25	3.8[c]
	24-Hour	5	2.2[c]
	Annual	1	0.07[c]
PM-10	24-Hour	5	9.4[c]
PM-2.5	24-Hour	1.2	6.5[e]
	Annual	0.3	0.32[d]

Note:
1-hr and 8-hr CO, 3-hr SO_2 includes 2CTs, AB, DFP, EDG
24-hr PM-10 & PM-2.5 includes 2CTs, AB, DFP, EDG, cooling tower
1-hr SO_2 and 1-hr NO_2 includes 2CTs, AB
Annual NO_2 and SO_2 includes 2CTs, AB, DFP, EDG
Annual PM-10 and PM-2.5 includes 2CTs, AB, DFP, EDG, cooling tower

[a]Includes use of PVMRM.
[b]Based upon maximum 1st highest maximum daily 1-hour results averaged over 5-years.
[c]Maximum modeled concentration.
[d]Maximum annual results averaged over 5-years.
[e]Based upon maximum 1st highest 24-hour results averaged over 5-years.

Maximum Modeled Keasbey Facility Concentrations During Startup/Shutdown Compared to NAAQS/NJAAQS

Pollutant	Averaging Period	NAAQS/ NJAAQS ($\mu g/m^3$)	Maximum Modeled Concentration ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	Total Concentration ($\mu g/m^3$)
CO	1-Hour	40,000	439.2[d]	2,415	2,854.2
	8-Hour	10,000	76.1[d]	1,495	1,571.1
NO_2	1-Hour	188	37.2[a]	71.4	112.7[c]
	Annual	100	0.38[d]	16.9	17.3[c]
SO_2	1-Hour	196	8.9[e]	12.0	20.9
	3-Hour	1,300	9.5[d]	13.9	23.4
	24-Hour	-/365	6.4[d]	5.5	11.9
	Annual	-/80	0.15[d]	0.8	0.95
PM-10	24-Hour	150	8.2[d]	33	41.2
PM-2.5	24-Hour	35	4.5[f]	18.2	22.7
	Annual	12	0.23[g]	8.1	8.3

[a]Maximum 8th highest maximum daily 1-hour results averaged over 5-years.
[c]Includes use of PVMRM.
[d]Maximum modeled concentration.
[e]Maximum 4th highest maximum daily 1-hour results averaged over 5-years.
[f]Maximum 8th highest maximum daily 24-hour results averaged over 5-years.
[g]Maximum annual results averaged over 5-years.

Maximum Modeled Woodbridge Facility Concentrations During Startup/Shutdown Compared to NAAQS/NJAAQS

Pollutant	Averaging Period	NAAQS/ NJAAQS ($\mu g/m^3$)	Maximum Modeled Concentration ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	Total Concentration ($\mu g/m^3$)
CO	1-Hour	40,000	1,428.5[d]	2,415	3,843.5
	8-Hour	10,000	498.4[d]	1,495	1,993.4
NO_2	1-Hour	188	58.0[a]	72.0	130.0[c]
	Annual	100	0.99[d]	16.9	17.9[c]
SO_2	1-Hour	196	4.7[e]	12.0	16.7
	3-Hour	1,300	3.8[d]	13.9	17.7
	24-Hour	-/365	2.2[d]	5.5	7.7
	Annual	-/80	0.07[d]	0.8	0.9
PM-10	24-Hour	150	9.4[d]	33	42.4
PM-2.5	24-Hour	35	3.8[f]	18.2	22.0
	Annual	12	0.32[g]	8.1	8.4

[a]Maximum 8th highest maximum daily 1-hour results averaged over 5-years.
[c]Includes use of PVMRM.
[d]Maximum modeled concentration.
[e]Maximum 4th highest maximum daily 1-hour results averaged over 5-years.
[f]Maximum 8th highest maximum daily 24-hour results averaged over 5-years.
[g]Maximum annual results averaged over 5-years.

Keasbey Facility Maximum Modeled Concentrations Due to Normal Operations Compared to NAAQS/NJAAQS

Pollutant	Averaging Period	NAAQS/ NJAAQS (μg/m3)	Maximum Modeled Concentration (μg/m3)	Background Concentration (μg/m3)	Total Concentration (μg/m3)
CO	1-Hour	40,000	377.6[d]	2,415	2,792.6
	8-Hour	10,000	77.1[d]	1,495	1,572.1
SO_2	1-Hour	196	3.6[e]	12.0	15.6
	3-Hour	1,300	4.0[d]	13.9	17.9
	24-Hour	-/365	2.6[d]	5.5	8.1
	Annual	-/80	0.07[d]	0.8	0.9
PM-10	24-Hour	150	8.2[d]	33	41.2
PM-2.5	24-Hour	35	3.7[f]	18.2	21.9
	Annual	12	0.19[g]	8.1	8.3
NO_2	1-Hour	188	18.9[a]	72.0	90.9[c]
	Annual	100	0.50[d]	16.9	17.4[c]

[a]Maximum 8th highest maximum daily 1-hour results averaged over 5-years.
[c]Includes use of PVMRM.
[d]Maximum modeled concentration.
[e]Maximum 4th highest maximum daily 1-hour results averaged over 5-years.
[f]Maximum 8th highest maximum daily 24-hour results averaged over 5-years.
[g]Maximum annual results averaged over 5-years.

Woodbridge Facility Maximum Modeled Concentrations Due to Normal Operations Compared to NAAQS/NJAAQS

Pollutant	Averaging Period	NAAQS/ NJAAQS (μg/m³)	Maximum Modeled Concentration (μg/m³)	Background Concentration (μg/m³)	Total Concentration (μg/m³)
CO	1-Hour	40,000	154.6[d]	2,415	2,569.6
	8-Hour	10,000	56.8[d]	1,495	1,551.8
SO_2	1-Hour	196	3.4[e]	12.0	15.4
	3-Hour	1,300	3.2[d]	13.9	17.1
	24-Hour	-/365	2.1[d]	5.5	7.6
	Annual	-/80	0.07[d]	0.8	0.9
PM-10	24-Hour	150	9.4[d]	33	42.4
PM-2.5	24-Hour	35	3.8[f]	18.2	22.0
	Annual	12	0.33[g]	8.1	8.4
NO_2	1-Hour	188	17.9[a]	72.0	89.9[c]
	Annual	100	0.98[d]	16.9	17.0[c]

[a]Maximum 8th highest maximum daily 1-hour results averaged over 5-years.
[c]Includes use of PVMRM.
[d]Maximum modeled concentration.
[e]Maximum 4th highest maximum daily 1-hour results averaged over 5-years.
[f]Maximum 8th highest maximum daily 24-hour results averaged over 5-years.
[g]Maximum annual results averaged over 5-years.

Keasbey Facility Maximum Modeled Class I Concentrations

Pollutant	Averaging Period	Class I Significant Impact Concentration (μg/m3)	Maximum Modeled Concentration (μg/m3)
SO_2	3-Hour	1.0	0.055[c]
	24-Hour	0.2	0.015[c]
	Annual	0.1	0.001[c]
PM-2.5	24-Hour	0.27[a]	0.037[c]
	Annual	0.06	0.004[c]
PM-10	24-Hour	0.3	0.042[c]
	Annual	0.2	0.003[c]
NO_2	Annual	0.1	0.003[b,c]

[a]A revised 24-hour PM-2.5 Class I SIL of 0.27 μg/m3 was proposed on August 18, 2016.
[b]Includes use of PVMRM.
[c]Maximum modeled concentration.

Notes:
U.S. EPA's proposed Class I SILs for NO_2, PM-10, and SO_2 were published in the July 23, 1996, Federal Register (61 FR 38249).
U.S. EPA's PM-2.5 Class I SILs codified in 40 CFR 52.21(k)(2) were vacated.
U.S. EPA's proposed Option 3 PM-2.5 Class I SILs were published in the September 21, 2007, Federal Register (72 FR 54112).

Woodbridge Facility Maximum Modeled Class I Concentrations

Pollutant	Averaging Period	Class I Significant Impact Concentration (μg/m³)	Maximum Modeled Concentration (μg/m³)
SO_2	3-Hour	1.0	0.058[c]
	24-Hour	0.2	0.017[c]
	Annual	0.1	0.001[c]
PM-2.5	24-Hour	0.27[a]	0.037[c]
	Annual	0.06	0.005[c]
PM-10	24-Hour	0.3	0.074[c]
	Annual	0.2	0.005[c]
NO_2	Annual	0.1	0.004[b,c]

[a]A revised 24-hour PM-2.5 Class I SIL of 0.27 μg/m³ was proposed on August 18, 2016.
[b]Includes use of PVMRM.
[c]Maximum modeled concentration.

Notes:
U.S. EPA's proposed Class I SILs for NO_2, PM-10, and SO_2 were published in the July 23, 1996, Federal Register (61 FR 38249).
U.S. EPA's PM-2.5 Class I SILs codified in 40 CFR 52.21(k)(2) were vacated.
U.S. EPA's proposed Option 3 PM-2.5 Class I SILs were published in the September 21, 2007, Federal Register (72 FR 54112).

Keasbey Facility Impact on NJAAQS

Pollutant	Averaging Period	Primary NJAAQS (ug/m3)	Maximum Modeled Concentration (μg/m3)	Background Concentration (μg/m3)	Total Concentration (μg/m3)
NO_2	12-Month	100	0.50[b,d]	16.9	17.4
CO	1-hour	40,000	377.6[d]	2,415	2,792.6
	8-hour	10,000	77.1[d]	1,495	1,572.1
SO_2	3-hour	---	4.0[d]	12.0	16.0
	24-hour	365	2.6[d]	13.9	16.5
	12-Month	80	0.07[d]	0.8	0.9
TSP[a]	24-hour	260	8.2[d]	33	41.2
	12-Month	75	0.23[d]	-	0.23
Lead	3-month	1.5	trace[d]	-	0.0001

[a]PM10 as TSP
[b]Includes use of PVMRM.
[d]Maximum modeled concentration.

Woodbridge Facility Impact on NJAAQS

Pollutant	Averaging Period	Primary NJAAQS (ug/m³)	Maximum Modeled Concentration (μg/m³)	Background Concentration (μg/m³)	Total Concentration (μg/m³)
NO_2	12-Month	100	1.0[b,d]	16.9	17.9
CO	1-hour	40,000	154.6[d]	2,415	2,569.6
	8-hour	10,000	56.8[d]	1,495	1,551.8
SO_2	3-hour	---	3.2[d]	12.0	15.2
	24-hour	365	2.1[d]	13.9	16.1
	12-Month	80	0.07[d]	0.8	0.9
TSP[a]	24-hour	260	9.4[d]	33	42.4
	12-Month	75	0.37[d]	-	0.37
Lead	3-month	1.5	trace[d]	-	trace

[a]PM10 as TSP
[b]Includes use of PVMRM.
[d]Maximum modeled concentration.

Keasbey Facility Comparison of Maximum Modeled Concentrations of Pollutants to Vegetation Screening Concentrations

Pollutant	Averaging Period	Maximum Modeled Concentration (µg/m³)	Background Concentration (µg/m³)	Total Concentration[a] (µg/m³)	Vegetation Screening Concentrations[f] (µg/m³)		
					Sensitive	Intermediate	Resistant
SO_2	1-Hour	3.9	12.0	15.9	917	-	-
	3-Hour	4.0	13.9	17.9	786	2,096	13,100
	Annual	0.07	0.8	0.9	-	18	-
NO_2	4-Hour	21.1[b]	72.0[c]	93.1	3,760	9,400	16,920
	8-Hour	21.1[b]	72.0[c]	93.1	3,760	7,520	15,040
	Annual	0.50	16.9	17.4	-	94	-
CO	1-Week	77.1[e]	1,495[d]	1,572.1	1,800,000	-	18,000,000

[a]Total concentration = maximum modeled facility concentration + background concentration.
[b]Maximum modeled concentration conservatively based on 1-hour averaging period.
[c]Maximum background concentration conservatively based on 1-hour averaging period.
[d]Maximum background concentration conservatively based on 8-hour averaging period.
[e]Maximum modeled concentration conservatively based on 8-hour averaging period.
[f]Screening concentrations found in Table 3.1 of "A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals" (EPA, 1980).
(-) No screening concentration available.

Woodbridge Facility Comparison of Maximum Modeled Concentrations of Pollutants to Vegetation Screening Concentrations

Pollutant	Averaging Period	Maximum Modeled Concentration (µg/m³)	Background Concentration (µg/m³)	Total Concentration[a] (µg/m³)	Vegetation Screening Concentrations[f] (µg/m³)		
					Sensitive	Intermediate	Resistant
SO_2	1-Hour	3.4	12.0	15.4	917	-	-
	3-Hour	3.2	13.9	17.1	786	2,096	13,100
	Annual	0.07	0.8	0.9	-	18	-
NO_2	4-Hour	18.6[b]	72.0[c]	90.6	3,760	9,400	16,920
	8-Hour	18.6[b]	72.0[c]	90.6	3,760	7,520	15,040
	Annual	1.0	16.9	17.9	-	94	-
CO	1-Week	56.8[e]	1,495[d]	1,551.8	1,800,000	-	18,000,000

[a]Total concentration = maximum modeled facility concentration + background concentration.
[b]Maximum modeled concentration conservatively based on 1-hour averaging period.
[c]Maximum background concentration conservatively based on 1-hour averaging period.
[d]Maximum background concentration conservatively based on 8-hour averaging period.
[e]Maximum modeled concentration conservatively based on 8-hour averaging period.
[f]Screening concentrations found in Table 3.1 of “A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals” (EPA, 1980).
(-) No screening concentration available.

Keasbey Facility VISCREEN Analysis Results

Background	Theta (degrees)	Azimuth (degrees)	Distance (km)	Alpha (degrees)	Delta E[a]		Contrast[b]	
					Criteria	Plume	Criteria	Plume
Inside Surrounding Area								
Sky	10.	84.	30.0	84.	3.79	0.035	0.06	0.000
Sky	140.	84.	30.0	84.	2.00	0.015	0.06	0.000
Terrain	10	84.	30.0	84.	3.51	0.052	0.06	0.001
Terrain	140.	84.	30.0	84.	2.00	0.010	0.06	0.000
Outside Surrounding Area								
Sky	10.	0.	1.0	168.	2.00	0.091	0.05	0.001
Sky	140.	0.	1.0	168.	2.00	0.020	0.05	-0.001
Terrain	10.	0.	1.0	168.	2.00	0.198	0.05	0.002
Terrain	140.	0.	1.0	168.	2.00	0.057	0.05	0.002

[a]Color difference parameter (dimensionless).
[b]Visual contrast against background parameter (dimensionless).

Woodbridge Facility VISCREEN Analysis Results

Background	Theta (degrees)	Azimuth (degrees)	Distance (km)	Alpha (degrees)	Delta E[a]		Contrast[b]	
					Criteria	Plume	Criteria	Plume
Inside Surrounding Area								
Sky	10.	84.	30.0	84.	3.79	0.037	0.06	0.000
Sky	140.	84.	30.0	84.	2.00	0.013	0.06	0.000
Terrain	10	84.	30.0	84.	3.51	0.035	0.06	0.000
Terrain	140.	84.	30.0	84.	2.00	0.006	0.06	0.000
Outside Surrounding Area								
Sky	10.	0.	1.0	168.	2.00	0.082	0.05	0.001
Sky	140.	0.	1.0	168.	2.00	0.014	0.05	-0.001
Terrain	10.	0.	1.0	168.	2.00	0.128	0.05	0.001
Terrain	140.	0.	1.0	168.	2.00	0.036	0.05	0.001

[a]Color difference parameter (dimensionless).
[b]Visual contrast against background parameter (dimensionless).

Message

From: Sareen, Neha [sareen.neha@epa.gov]
Sent: 8/23/2021 2:15:04 PM
To: Colecchia, Annamaria [Colecchia.Annamaria@epa.gov]; elvira.brankov@dec.ny.gov; john.kent [john.kent@dec.ny.gov]
Subject: RE: Astoria Gen Station
Attachments: Astoria Gas Turbine LLC Air Permit Application Revision 5-28-2021-rcd Aug2021.pdf

Hi John, Elvira,

This is a Title V Major Mod where the facility is replacing 24 existing gas and fuel CTGs with single CTG. They are PSD effective for PM2.5/PM10. Attaching the air permit application.

Talk to you soon.

From: Colecchia, Annamaria <Colecchia.Annamaria@epa.gov>
Sent: Monday, August 23, 2021 10:08 AM
To: elvira.brankov@dec.ny.gov; john.kent <john.kent@dec.ny.gov>
Cc: Sareen, Neha <sareen.neha@epa.gov>
Subject: RE: Astoria Gen Station

Yes, we understand. We just want to chat to be clearer on some of the questions. Thanks. Talk to you soon.

From: Brankov, Elvira (DEC) <elvira.brankov@dec.ny.gov>
Sent: Monday, August 23, 2021 9:59 AM
To: john.kent <john.kent@dec.ny.gov>; Colecchia, Annamaria <Colecchia.Annamaria@epa.gov>
Cc: Sareen, Neha <sareen.neha@epa.gov>
Subject: RE: Astoria Gen Station

Yes, that's the project I have. I do have an updated version of the Protocol and the Modeling Report. I can forward those if you think they would be helpful, but as John said this was a minor modification, only 1-hour NO2 modeling.
Thanks,
Elvira

From: Kent, John W (DEC) <john.kent@dec.ny.gov>
Sent: Monday, August 23, 2021 9:02 AM
To: Colecchia, Annamaria <Colecchia.Annamaria@epa.gov>
Cc: Sareen, Neha <sareen.neha@epa.gov>; Brankov, Elvira (DEC) <elvira.brankov@dec.ny.gov>
Subject: RE: Astoria Gen Station

Hi Annamaria –

Is the attached protocol about the same project you are inquiring about? There are multiple facilities with Astoria in their name. If this is the one in question, this was a minor modification, so some of the items you mention would not be applicable.

John

From: Colecchia, Annamaria <Colecchia.Annamaria@epa.gov>
Sent: Wednesday, August 18, 2021 10:20 AM
To: Kent, John W (DEC) <john.kent@dec.ny.gov>

Cc: Sareen, Neha <sareen.neha@epa.gov>
Subject: RE: Astoria Gen Station

ATTENTION: This email came from an external source. Do not open attachments or click on links from unknown senders or unexpected emails.

Btw, just so you know, these are some of the questions that we were wondering if you could clarify:

- Preconstruction ambient monitoring waiver. Missing monitor data from pollutants (except PM2.5, PM10).
- Possible use of flapper caps on one of the stacks (for the emergency generator) and why it won't restrict vertical discharge
- Intermittent sources being exempt from 1-hr SO2 and 1-hr NO2 modeling – maybe okay by NY regs
- 1-hr NO2 modeling – need more information for the ARM2 method
- Do not have a response from the Federal Land Managers regarding need for AQRV analysis.
- Make sure that permit has modeled time limit (20 min) and emission rate for startup.
- Suggesting cumulative analysis
- EJ analysis

From: Colecchia, Annamaria
Sent: Wednesday, August 18, 2021 9:41 AM
To: John Kent <john.kent@dec.ny.gov>
Cc: Sareen, Neha <sareen.neha@epa.gov>
Subject: Astoria Gen Station

Hi John,

We were wondering if you and the modeler who reviewed the Astoria Gen Station application were available this morning to clarify some questions we had? It would have to be before noon today or anytime next Monday. Please let us know when is a good time and we can send out a Team invite. Thanks.

Annamaria

AECOM

Prepared for:
Astoria Gas Turbine Power LLC

Prepared by:
AECOM
Revised May 2021

Title V Air Permit Major Modification Turbine Replacement Project

Astoria Gas Turbine Power LLC
Astoria, Queens County, New York

AECOM

Prepared for:
Astoria Gas Turbine Power LLC

Prepared by:
AECOM
Revised May 2021

Title V Air Permit Major Modification Turbine Replacement Project

Astoria Gas Turbine Power LLC Astoria, Queens County, New York

Brian Stormwind Ian Miller

Prepared by Brian Stormwind and Ian Miller

James H Slack

Reviewed by Jim Slack

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List of Acronyms

AGC	Annual Guideline Concentration
AQRV	air quality related value
amsl	above mean sea level
ARM2	Ambient Ratio Method 2
BACT	Best Available Control Technology
BFE	base flood elevation
BESS	battery energy storage system
CAA	Clean Air Act
CAM	compliance assurance monitoring
CARB	California Air Resources Board
CCS	carbon capture and sequestration
CEMS	continuous emissions monitoring system
CFR	Code of Federal Regulations
CH_4	methane
CI	compression ignition
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
CP-29	NYSDEC Commissioner Policy-29, Environmental Justice and Permitting
CRRA	Community Risk and Resiliency Act
CSAPR	Cross State Air Pollution Rule
CTG	combustion turbine generator
DAR	NYSDEC Division of Air Resources
DAR-10	NYSDEC dispersion modeling guidelines
DLN	dry low-NOx
DPF	diesel particulate filters
DSEIS	Draft Supplemental Environmental Impact Statement
°F	degrees Fahrenheit
°K	degrees Kelvin
EAP	Environmental Appeals Board
ECL	Environmental Conservation Law
ECMPS	Emissions Collection and Monitoring System
e-GRRT	USEPA's electronic Green House Reporting Tool
EJ	Environmental Justice

EPPP	Enhanced Public Participation Plan
ERC	emission reduction credit
FAA	Federal Aviation Administration
FEIS	Final Environmental Impact Statement
FLM	Federal Land Manager
ft	feet
FWS	Fish and Wildlife Service
gal/yr	gallons per year
GAQM	Guideline on Air Quality Models
GE	General Electric
GEP	Good Engineering Practice
GHG	greenhouse gas
GIS	Geographic Information System
GWP	Global Warming Potential
GWP20	Global Warming Potential 20-year
g/hp-hr	grams per horsepower-hour
g/kWm-hr	grams per kilowatt (mechanical)-hour
g/sec	grams per second
HAP	hazardous air pollutant
H_2O	water
H_2SO_4	sulfuric acid mist
HHV	higher heating value
HOD	NYSDOH Health Outcome Data
hrs/yr	hours per year
IPCC	Intergovernmental Panel on Climate Change
ISO	International Organization for Standardization
kg	kilograms
kPa	kilopascal
km	kilometers
kV	kilovolt
kWe	kilowatts (electrical)
kWm	kilowatts (mechanical)
LAER	lowest achievable emission rate
lbs	pound
lb/hr	pounds per hour
lb/MMBtu	pounds per million Btu

lb/MW-hr	pounds per megawatt (electrical)-hour
LFP	lithium iron phosphate
m	meters
m^3	cubic meters
MACT	Maximum Achievable Control Technology
MATS	Mercury and Air Toxics
MECL	minimum emission limit compliance level
MERP	Modeled Emission Rates for Precursors
MMBtu	Million British Thermal Units
MMBtu/hr	Million British Thermal Units per hour
MRCSP	Midwest Regional Carbon Sequestration Partnership
m/sec	meters per second
MSA	Metropolitan Statistical Area
MWe	megawatts (electrical)
PEJA	potential environmental justice area
PSC	New York State Public Service Commission
PSD	Prevention of Significant Deterioration
PSL	Public Service Law
$\mu g/m^3$	micrograms per cubic meter
N/A	not applicable
NAAQS	National Ambient Air Quality Standards
NAD 83	North American Datum of 1983
NED	National Elevation Data
NESHAP	National Emission Standard for Hazardous Air Pollutant
ng/J	nanograms per Joule
NNSR	nonattainment new source review
N_2	nitrogen
NH_3	ammonia
NO	nitric oxide
NO_2	nitrogen dioxide
N_2O	nitrous oxide
NOx	oxides of nitrogen (includes NO_2)
NPCC	Northeast Power Coordinating Council
NSPS	New Source Performance Standards
NSR	new source review
NYCRR	New York Codes, Rules, and Regulations

NYISO	New York Independent Systems Operator
NYPA	New York Power Authority
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
O_2	oxygen
O_3	ozone
OAQPS	Office of Air Quality Planning and Standards
OFO	Operational Flow Orders
OLM	ozone limiting method
Pb	lead
PCS	power conversion system
PEJA	potential environmental justice area
PEP	project emission potential
PM	particulate matter
PM_{10}	particulate matter sized 10 microns and smaller (also called inhalable particulate matter)
$PM_{2.5}$	particulate matter sized 2.5 microns and smaller (also called fine particulate matter)
%	percent
ppmvdc	parts per million by volume, dry basis, corrected to 15 percent oxygen
ppmw	parts per million by weight
PSD	Prevention of Significant Deterioration
psi	pounds per square inch
psia	pounds per square inch absolute
PVMRM	plume volume molar ratio method
P&W	Pratt and Whitney
Q/D	emission rate (tpy) divided by distance to PSD Class I area (km)
RACT	reasonably available control technology
RBLC	RACT/BACT/LAER Clearinghouse
RGGI	Regional Greenhouse Gas Initiative
scf	standard cubic foot
SCR	selective catalytic reduction
SD	shutdown
SEIS	supplemental environmental impact statement
SEQRA	State Environmental Quality Review Act
SF_6	sulfur hexafluoride

SGC	sort-term guideline concentration
SIL	significant impact level
SIP	State Implementation Plan
SO_2	sulfur dioxide
SO_3	sulfur trioxide
SNEIT	Significant Net Emission Increase Threshold
SPDES	State Pollutant Discharge Elimination System
SPT	Significant Project Threshold
SU	start-up
TMNSR	10-minute Non-Synchronized Reserves
tpy	tons per year
ULSD	ultra low sulfur distillate
ULSK	ultra low sulfur kerosene
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VOC	volatile organic compounds

1.0 Introduction

1.1 Project Overview

Astoria Gas Turbine Power LLC ("Astoria"), is proposing to modify its previously approved project ("Replacement Project" or "Project") and replace 24 existing natural gas and liquid fuel fired combustion turbine generators ("CTG") at the Astoria Gas Turbine Generating Facility ("Astoria" or "Facility") with a single new state-of-the-art simple cycle CTG. The Astoria Facility is located on a 15-acre site at 31-01 20th Ave., Astoria, Queens County, New York and is situated within an approximately 300-acre complex (referred to as the "Astoria ConEd Complex"), which is home to several power generating facilities, as well as barge delivery facilities, a liquefied natural gas plant, a decommissioned wastewater treatment plant, and other miscellaneous energy and utility scale operations. This area has been the site of electrical generation, transmission, distribution and associated energy activities since the 1890s and remains exclusively a major electric generating and manufacturing complex.

The Project, as previously configured and permitted in 2010, consisted of replacing the existing CTGs with 4 General Electric ("GE") 7F.04 CTGs and four steam turbine generators to create a combined cycle facility comprised of four 1x1 units capable of generating 1,040 electrical megawatts ("MWe"). However, the Project was not constructed at that time due to prevailing market conditions.

The Facility currently consists of 31 older, peaking-only gas and oil-fired CTGs including 24 Pratt & Whitney ("P&W") turbines and seven previously retired Westinghouse turbines, with a combined nameplate rating of 646 MWe. The Project, as modified, will replace all of the nearly 50-year-old 24 operating P&W CTGs and the seven Westinghouse CTGs at the Facility with a new state-of-the-art simple cycle dual-fuel peaking CTG. Emissions reductions from the permanent shutdown of existing turbines will be used as netting offsets for the Project potential emissions. The Project is planned to become operational in 2023 following a construction period starting in 2021.

The Project will include a new highly efficient, fast-starting, GE H-Class 7HA.03 unit (or equivalent) with a nominal generator output of approximately 437 MWe. The new CTG will fire natural gas as the primary fuel with limited ultra-low sulfur distillate ("ULSD") liquid fuel for backup. The CTG will operate on ULSD up to a maximum of 21.954 million gallons per year on a 12-month rolling basis. The following operating conditions are included in this amount:

- 720 hours per year at steady-state;
- Start-up and shutdown ("SU/SD") events; and
- Fuel switching.

The Project will also include a ULSD-fired emergency generator for safe shutdown and two ULSD-fired emergency fire system pumps. The Project will use the two existing ultra low-sulfur kerosene ("ULSK") tanks to store ULSD for the new CTG.

All of the existing units, with the exception of one P&W Twin Pac (consisting of two combustion turbines and a single generator), will be permanently shut down no later than the date when the Project has completed its shakedown period as defined in Title 6 of the New York Codes, Rules and Regulations ("NYCRR") section 231-3.8 (6 NYCRR 231-3.8). The two remaining P&W turbines will remain operational to make the site black-start capable until replaced by an approximately 24 MWe battery energy storage system ("BESS").[1] These remaining two P&W turbines will be limited to 12 hrs/yr operation and will be fueled primarily with natural gas with ULSK as backup which will be stored in a new 7,500-gallon tank.

1.2 Regulatory Overview

The Project is located in the New York City Borough of Queens which is designated as attainment/unclassified with respect to the National Ambient Air Quality Standards ("NAAQS") for all criteria pollutants with the exception of ozone ("O_3"). The New York State Department of Environmental Conservation ("NYSDEC") has classified the New York City Metropolitan Area (which includes the Project site) as a serious ozone nonattainment area based on the 2008 1-hour O_3 standard. The Project will be a modification of the existing Facility, which is classified as a major source under both 6 NYCRR Part 231 Prevention of Significant Deterioration ("PSD") and Non-Attainment New Source Review ("NNSR") air permitting programs.

Based upon the project emission potential ("PEP") estimates provided in Section 2, the Project is subject to PSD review for emissions of particulate matter ("PM"), particulate matter with a diameter equal to or less than 10 microns ("PM_{10}"), particulate matter with a diameter equal to or less than 2.5 microns ("$PM_{2.5}$") and greenhouse gases ["GHG", expressed as carbon dioxide equivalents ("CO_2e")]. The Project will not trigger NNSR for either nitrogen oxides ("NO_X") or volatile organic compounds ("VOC") emissions with respect to O_3 nonattainment.

In accord with PSD requirements, a Best Available Control Technology ("BACT") emission control review is presented in Section 4 for pollutants subject to PSD review: PM/PM_{10}/$PM_{2.5}$ and GHG. Emissions of PM, PM_{10}, and $PM_{2.5}$ will be controlled by the use of low sulfur fuels with natural gas as the primary fuel for the CTG. GHG emissions will be minimized by the use of a high efficiency simple cycle CTG fired with natural gas as the primary fuel, with limited firing of ULSD. The Project will comply with the NAAQS and all applicable New Source Performance Standards ("NSPS") and National Emission Standards for Hazardous Air Pollutants ("NESHAP"s).

The new CTG will be equipped with dry-low-NO_X ("DLN") burners and selective catalytic reduction ("SCR") to control NO_X emissions. In addition, water will be emulsified with ULSD to control NO_X when firing liquid fuel. Emissions of carbon monoxide ("CO") and VOC's from the CTG will be controlled with good combustion practices and an oxidation catalyst system.

1.3 Application Overview

This PSD Permit application is composed of eight sections as described herein. Section 1 provides an overview of the Project and regulatory requirements. Section 2 provides a detailed description of the proposed Project, including estimated emissions. Section 3 provides a detailed review of regulations applicable to the proposed Project. Section 4 provides the PSD BACT evaluation. An air quality modeling analysis demonstrating compliance for criteria pollutants with the NAAQS, PSD increments, and other PSD modeling requirements is provided in Section 5. Section 5 also includes an air quality modeling analysis for air toxic compounds in accordance with NYSDEC's Division of Air Resources ("DAR") -1 (2016a) for evaluating air toxic compounds relative to the Short-term and Annual Guideline Concentrations ("SGCs" and "AGCs", respectively), discussion of background air quality and pre-construction ambient monitoring, as well as additional PSD impact analyses. Consistency with the

[1] Conversion to the black-start battery energy storage system may require prior approval from Con Edison, the New York Independent System Operator (NYISO) and the Federal Energy Regulatory Commission (FERC).

Climate Leadership and Community Protection Act ("CLCPA"), including an assessment of disadvantaged communities, is discussed in Section 6. References are listed in Section 7.

The NYSDEC permit application forms and supporting attachments are provided in Appendix A; the Project site plan is provided in Appendix B; emission calculation spreadsheets providing supporting calculations for the application and equipment information are provided in Appendix C; Appendix D presents summary tables supporting the PSD BACT analyses; Appendix E contains supporting information for the dispersion modeling analysis; Appendix F contains a GHG and CLCPA consistency analysis prepared by Navigant Consulting, Inc. n/k/a Guidehouse; Appendix G contains a copy of the Class I Area waiver request submitted to the Federal Land Managers ("FLM"); and Appendix H contains a copy of the Obstruction Evaluation/Airport Airspace Analysis norificaiton of the proposed CTG stack construction provided to the Federal Avaiation Administration ("FAA").

1.4 Applicant Contacts

The applicant for this application is Astoria Gas Turbine Power LLC. The primary contacts for this application are:

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2.0 Project Description

2.1 Project Location and Layout

The Project will be constructed at the existing Facility on a portion of the site currently occupied by the existing Westinghouse turbines. The Facility location is shown in **Figure 2-1**. The site plan showing the locations of the CTG and ancillary equipment is provided in **Appendix B**.

2.2 Project Summary

As previously described, the Replacement Project will replace existing operating gas and oil-fired combustion turbines at the Astoria Facility with a new state-of-the-art simple cycle CTG unit. The Replacement Project is expected to address a 220 MWe reliability shortfall identified by the New York Independent System Operator and Con Edison in the Astoria East Transmission Load Area[2].

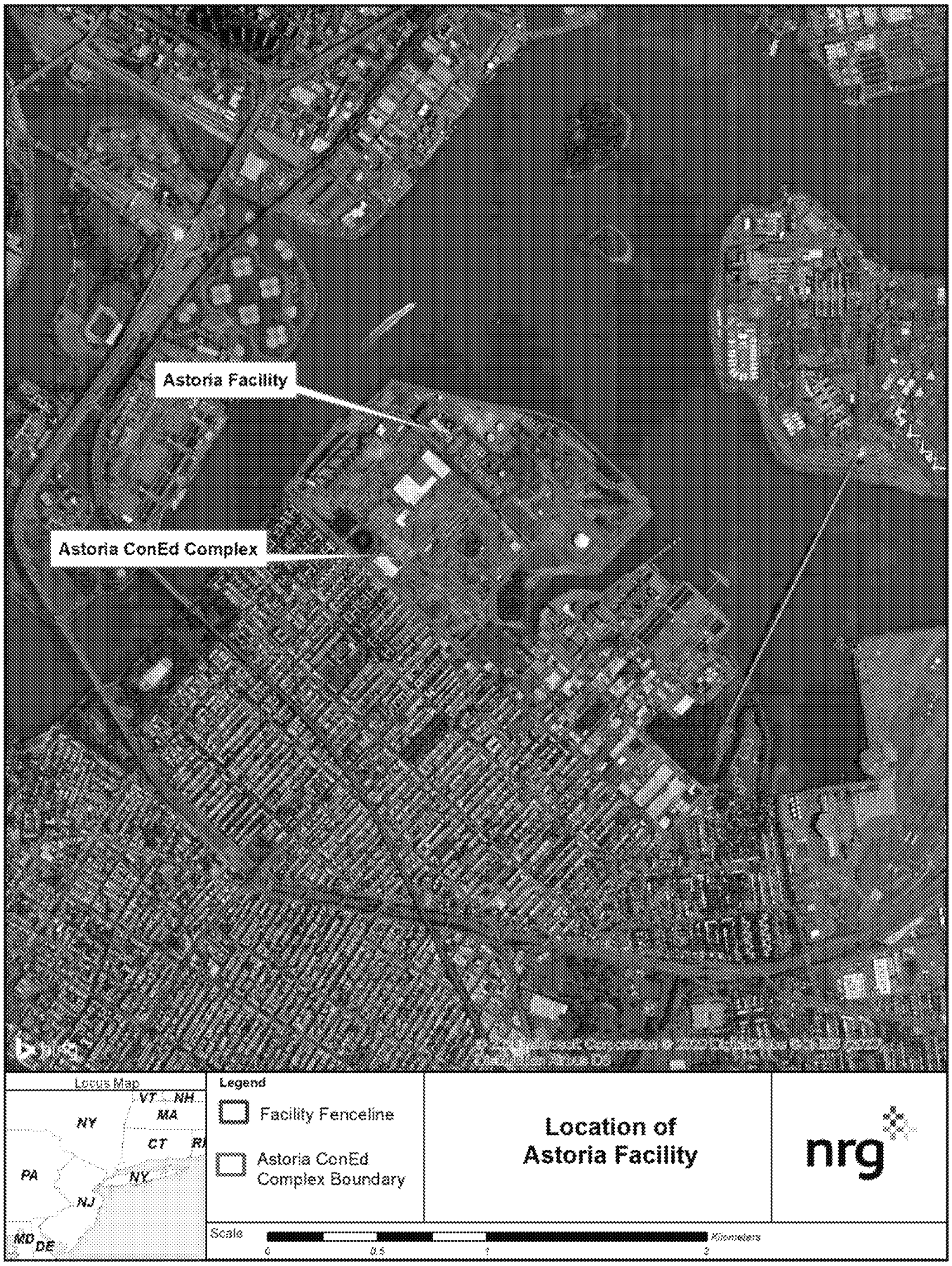
The primary air emission source associated with the Project is the new CTG rated at approximately 437 MWe operating in simple cycle mode to provide electric power during periods of peak demand. The CTG generating system will primarily include: one GE H-Class 7HA.03 CTG (or equivalent); an evaporative inlet air cooler; tempering air fans; SCR system, complete with an ammonia ("NH_3") injection skid; oxidation catalyst; exhaust stack; three (3) two-winding main generator step-up transformers; auxiliary and isolation transformers; and electrical switchgear.

Emissions controls and control strategies for the CTG include:

- Low NOx combustion technology will provide a 25 parts per million by volume, dry basis, corrected to 15 percent oxygen ("ppmvdc") NOx CTG emission rate at the turbine exhaust flange during post start-up, natural gas steady-state operating levels.
- Water emulsion with ULSD providing a 42 ppmvdc NOx CTG emission rate at the turbine exhaust flange during post-start up, ULSD steady-state operating levels.
- Tempering air combined with conventional SCR will be used to control NOx, providing 2.5 ppmvdc (natural gas) / 5 ppmvdc (ULSD) discharge rates for NOx emissions to the atmosphere (top of stack); NH_3 slip of 5 ppmvdc for both natural gas and ULSD.
- Good combustion management systems will provide initial control of CO, VOCs and hazardous air pollutant ("HAP") emissions exiting the CTG.
- Catalytic oxidation will provide additional control of CO, VOC, and organic HAP emissions.
- Use of prompt start and fast ramp procedures minimizing the SU/SD emissions. (The CTG unit will be able to achieve compliance with steady-state emission limits within a maximum of 30 minutes of initiating fuel combustion in the CTG.)
- Control system will be designed to achieve stack emissions compliant operation at any load between minimum emissions compliant load ("MECL") and base load across the prescribed ambient temperature range.
- The use of natural gas as the primary fuel and limited use of ULSD minimizing sulfate, fine particulate, and sulfuric acid formation.

[2] NYISO 2019-2028 Comprehensive Reliability Plan, July 16, 2019, Con Edison assessment begins on Page 15 https://www.nyiso.com/documents/20142/2248481/2019-2028CRP-FinalReportJuly-2019.pdf/51b573b7-9edb-bbb9-8a87-742e9e7c3b7f

Figure 2-1 Facility Location



- Use of natural gas as the primary fuel and a high efficiency CTG to minimize GHG.

Air emissions from the CTG unit will be discharged to the atmosphere from a new 250-foot ("ft") stack to be constructed as part of the Project.

The Project will also include ancillary emission sources including one 500 electrical kilowatt ("kWe") ULSD-fired emergency generator and two ULSD-fired emergency fire system pumps; 117 and 177 mechanical kilowatt ("kWm"), respectively. As noted, one existing P&W Twin Pac consisting of two turbines will remain operational to maintain black-start capability for the site until replaced by a battery energy storage system.

ULSD for the CTG will be stored in the existing ULSK tanks. There will also be one new 7,500-gallon ULSK tank to provide fuel for black-start operation of the remaining two P&W turbines. One new fully diked aqueous NH_3 storage tank with a capacity of 20,000 gallons will provide 19% aqueous NH_3 solution for the SCR system.

A table summarizing the proposed emissions and source operating limits and the methods used to determine compliance with those limits is provided in Appendix A.

2.3 Simple Cycle Combustion Turbine

The Project will utilize a GE H-Class 7HA.03 CTG (or equivalent) that will operate in simple cycle mode. The thermal energy from combustion of fuel is converted to mechanical energy, which drives an integral compressor and electric generator. Simple cycle operation allows for the CTG to respond quickly to the needs of the New York Independent System Operator ("NYISO") regional transmission system.

The CTG is comprised of three major sections: the compressor; the combustor, and the power turbine, as described below:

- In the compressor section, ambient air is drawn through a filter (and under certain meteorological conditions, the evaporative cooler) to clean (and cool) the air. The air is then compressed and directed to the combustor section. At times, water is injected into the compressor section to boost output (wet compression).
- The primary fuel that will be utilized by the CTG is natural gas, with limited firing of ULSD. The CTG will utilize DLN combustors to control NO_X formation during natural gas firing by pre-mixing fuel and air immediately prior to combustion. During ULSD firing, water and USLD will be mixed in the ULSD manifold (i.e., ULSD/water emulsion) and injected into the combustor to minimize peak flame temperature and reduce NO_X formation.
- In the combustor section, a fuel and air mixture is introduced and combusted. Hot gases from combustion are diluted with additional air from the compressor section and directed to the power turbine section at high temperature and pressure.
- In the power turbine section, the hot exhaust gases expand and rotate the turbine blades, which are coupled to a shaft. The rotating shaft drives the compressor and the generator, which generates electricity.

Cooling systems will include a cooling fan module that utilizes an air-cooled heat exchanger. The cooling fan module discharges heat generated from the operation of the GTG and auxiliary equipment which is transferred to a mixture of water and propylene glycol. This liquid is then pumped to the cooling fan module where fans blow air over a series of tubes that contain the hot liquid, transferring the heat to the atmosphere. The cooled liquid is then returned to the equipment, creating a continuous, closed loop heat transfer process.

The electrical output of the CTG varies with ambient temperature. At lower temperatures, the density of the combustion air is higher, and more mass can be injected into the combustor which results in higher electrical output from the power turbine. In warm weather when air density is lower, an evaporative cooler may be utilized to cool the combustion air in order to achieve greater electrical output. The gross electrical output of the CTG operating at full load will vary from approximately 436 MWe (firing natural gas at an ambient temperature of 100 degrees Fahrenheit (°F) with evaporative cooling and wet compression) (or 405 MWe with evaporative cooling but without wet compression or 368 MWe without evaporative cooling and wet compression) to approximately 438 MWe (firing ULSD at an ambient temperature of 19°F without either evaporative cooling or wet compression). The net electrical output of the CTG will be slightly less due to internal (plant) loads from auxiliary equipment associated with the Project. The CTG will have a heat input while firing natural gas of approximately 3,906 million British thermal units per hour ("MMBtu/hr") higher heating value ("HHV") at 100 percent ("%") load, 59°F and 60% relative humidity with evaporative cooling. At the same conditions while firing ULSD, the CTG will have a heat input of approximately 3,962 MMBtu/hr (HHV).

After passing through the CTG, the hot exhaust gases will be sent through an oxidation catalyst and SCR to control CO, VOC and NO_X emissions. The temperature of the exhaust at the stack will be approximately 840°F. The new CTG exhaust stack will be constructed of steel and is proposed to be 250 feet tall, with a 28.5-ft internal diameter. With the base of the exhaust stack proposed at 18 ft – 6 inches above mean sea level ("amsl") relative to North American Vertical Datum of 1988 ("NAVD 83"), the top of stack is proposed at elevation of 268.5 feet amsl.

2.3.1 Air Pollution Control Equipment

The emission control technologies proposed for the CTG include DLN combustors, SCR to control NO_X emissions, and an oxidation catalyst to control CO, VOC, and organic HAP emissions. When firing ULSD, water emulsion will also be used to minimize NO_X emissions prior to the SCR. DLN combustors are integrated within the CTG; the SCR and oxidation catalyst will be located within a separate housing. Due to the elevated temperature of the exhaust gas from the CTG (>1,000°F), a tempering air system will be employed to inject ambient air into the exhaust gas and lower its temperature to within the proper range (around 850°F) for operation of the SCR and oxidation catalyst.

The DLN combustors control NO_X formation during natural gas firing by pre-mixing fuel and air immediately prior to combustion. Pre-mixing inhibits NO_X formation by minimizing both the flame temperature and the concentration of oxygen ("O_2") at the flame front. During liquid fuel firing, a ULSD/water emulsion will be injected into the combustor, effectively mixing with the combustion air. By injecting water into the combustion zone, the peak flame temperature will be minimized resulting in lower thermal NO_X formation.

CO, VOC and organic HAP formation will be minimized by combustor design and good combustion practices to ensure complete combustion of the fuel. Emissions of $PM/PM_{10}/PM_{2.5}$, sulfur dioxide ("SO_2") and sulfuric acid ("H_2SO_4") will be minimized through use of natural gas as the primary fuel and ULSD to a maximum sulfur content of 15 parts per million by weight ("ppmw"). GHG will be minimized by use of natural gas as the primary fuel, limited firing of ULSD, and the CTG's ability to produce electricity in a highly efficient manner.

2.3.1.1 Selective Catalytic Reduction

SCR, a post-combustion chemical process, will treat exhaust gases downstream of the CTG. The SCR process will use 19% aqueous NH_3 as a reagent. Aqueous NH_3 will be injected into the flue gas stream upstream of the SCR catalyst (and downstream of the oxidation catalyst), where it will mix with NO_X. The catalyst bed will be located in a separate housing along with the oxidation catalyst. The temperature of the SCR will be maintained within its designed operating zone by the introduction of ambient air into the exhaust gas from the CTG to cool the exhaust gas. The temperature-controlled exhaust gases with the injected NH_3 will pass over the catalyst and the NO_X will be reduced to nitrogen gas ("N_2") and water ("H_2O"). The SCR system will reduce NO_X concentrations to 2.5 ppmvdc during natural gas firing and 5.0 ppmvdc during ULSD firing, across all steady-state operating loads and ambient temperatures.

A small amount of NH_3 will remain un-reacted through the catalyst, which is called "ammonia slip." The ammonia slip will be limited to 5.0 ppmvdc at all load conditions and ambient temperatures for both fuels.

2.3.1.2 Oxidation Catalyst

An oxidation catalyst system will be located within the same housing as the SCR to control emissions of CO, VOC, and organic HAPs. Exhaust gases from the CTG will flow through the catalyst bed where the CO, VOC, and HAPs will oxidize to form carbon dioxide ("CO_2") and H_2O. The oxidation catalyst system will reduce CO concentrations to 4.0 ppmvdc in the exhaust gas during natural gas firing and 5.0 ppmvdc during ULSD firing, across all steady-state operating loads and ambient temperatures. VOC will be limited to 2.0 ppmvdc for both fuels. Organic HAPs are expected to be reduced by 40%.

2.4 Ancillary Equipment

2.4.1 Emergency Diesel Generator

The purpose of the emergency diesel generator is to provide power to critical equipment in the event of a power failure, including the distributed control system, CTG turning gear, CTG lube oil pumps, as well as lighting and communication systems. The emergency diesel generator will be rated at approximately 500 kWe (555 kWm) and will be fired with ULSD. The engine will be an EPA certified Tier 4 engine that will satisfy the emissions requirements of Title 40 of the Code of Federal Regulations ("CFR"), Part 60 Subpart IIII. The emergency diesel generator will be a package unit that will contain a ULSD tank. Operation of the emergency generator engine will be limited to no greater than 500 hrs/yr, including testing, maintenance and emergency use.

The emergency generator will be equipped with a dedicated exhaust stack (13 feet above grade).

2.4.2 Emergency Diesel Fire System Pumps

Four fire pumps will be provided to ensure 100% backup of the fire protection system. Two fire pumps will be driven by electric motors and the other two will be driven by diesel engines. Each pump will be capable of delivering total system requirements at design pressure and flow rate with any one pump out of service. The diesel-engine-driven fire pumps will be rated at 117 kWm and 177 kWm, respectively, and will be fired with ULSD. The engines will be certified fire pump engines according to the emissions requirements of 40 CFR 60 Subpart IIII. Fuel supply for the fire pump will be located in a tank adjacent to the pump. Operation of the emergency fire pump engines will be limited to no greater than 500 hrs/yr per engine, including testing, maintenance, and emergency use.

The diesel-engine-driven fire system pumps will each be equipped with dedicated exhaust stacks (17 feet above grade).

2.4.3 P&W Twin Pac Black-Start Unit

All of the existing units, with the exception of one P&W Twin Pac consisting of two turbines, will be permanently shut down no later than the date when the Project has completed its shakedown period as defined in 6 NYCRR 231-3.8. The remaining P&W turbines will remain operational to make the site black-start capable until replaced by the BESS (Section 2.4.4). Operation of the remaining two P&W turbines will be limited to 12 hours/year and will primarily be fueled with natural gas with ULSK as backup which will be stored in a new 7,500-gallon tank.

2.4.4 Black-Start Battery Energy Storage System

The project plans to install a 24 MWe 1-hour duration BESS to start the new CTG in the event of a complete loss of offsite power. This system will include nine (9) lithium iron phosphate ("LFP") battery banks, nine (9) power conversion system ("PCS") skids and two (2) harmonic filters.

2.4.5 ULSD Storage Tanks

The two existing 2,000,000 gallon ULSK nominal tanks will be used to store ULSD for the CTG.

2.4.6 Aqueous Ammonia Storage Tank

A new 19% aqueous NH_3 storage tank with a capacity of 20,000 gallons will be provided to store NH_3, the reagent for the SCR system.

2.4.7 ULSK Storage Tank

A new ULSK storage tank with a capacity of 7,500 gallons will be installed to provide fuel to the existing P&W turbines being reserved for black-start operations.

2.4.8 Fugitive Sources

The Replacement Project will include new equipment which have the potential for fugitive emissions. New circuit breakers will be installed having an overall capacity of 330.7 pounds ("lbs") [150 kilograms ("kg")] of sulfur hexafluoride ("SF_6"). New natural gas system components will be added to the facility for the CTG. While these components are not designed to produce emissions, there is potential for small fugitives to occur.

2.5 Air Emissions

Table 2-1 presents a summary of the estimated maximum hourly emissions in pounds per hour ("lb/hr") for PSD-regulated pollutants emitted from the CTG at steady-state operation. Emission rates for air toxic compounds are provided in Appendix C. Calculations for emission rates for all steady-state operating conditions and ambient temperatures are provided in Appendix C. GHG emissions were calculated based on the revised global warming potentials ("GWP") for the various greenhouse gases included in the recent revisions to 6 NYCRR section 231-13.9, Table 9.

Table 2-1 Summary of Estimated Maximum Hourly Emissions (lb/hr) for the CTG (Steady-State Operation)

Pollutant[(1)]	Natural Gas Firing[(2, 3)]	ULSD Firing[(2, 3)]
NO_X	36.48	77.61
VOC	10.15	10.80
CO	31.08	47.23
PM	25.30	71.10
PM_{10}	25.30	71.10
$PM_{2.5}$	25.30	71.10
SO_2	5.56	6.13
H_2SO_4	3.66	4.04
Lead (Pb)	N/A[(4)]	0.056
GHG as CO_2e	232.55 (tons/hr)	326.18 (tons/hr)

(1) Emission rates for other PSD-regulated pollutants [fluorides, total reduced sulfur, reduced sulfur compounds, and hydrogen sulfide] are negligible (<0.001 lb/hr).

(2) Project may exceed these emission rates during defined periods of start-up, shutdown, fuel switching and malfunction.

(3) Maximum mass emission rate across all steady-state loads and ambient temperatures.

(4) There are no established emission factors for lead from natural gas-fired combustion turbines. Use of USEPA AP-42 emission factor for natural gas-fired boilers results in a maximum emission rate of <0.002 lb/hr.

Emissions during start-up, shutdown, and fuel switching may, for some pollutants, result in an increase in short-term (lb/hr) emission rates. Estimated emission rates for these non-steady-state operating conditions are provided in Appendix C.

Hourly emissions of air contaminants from ancillary equipment have been estimated based upon vendor emission guarantees, vendor emission estimates, U.S. Environmental Protection Agency ("USEPA") emission factors, mass balance calculations, and engineering estimates and are summarized in Table 2-2. Calculations are provided in Appendix C.

Table 2-2 Summary of Estimated Maximum Hourly Emissions (lb/hr) for Ancillary Equipment

Pollutant[1]	Emergency Generator Engine	Fire Pump Engine #1	Fire Pump Engine #2
NO_X	0.82	1.03	1.56
VOC	0.23	0.039	0.047
CO	4.28	1.29	1.37
PM	0.04	0.08	0.08
PM_{10}	0.04	0.08	0.08
$PM_{2.5}$	0.04	0.08	0.08
SO_2	0.008	0.002	0.003
H_2SO_4	0.0012	0.0003	0.0004
Pb[2]	n/a	n/a	n/a
GHGs (as CO_{2e})	817	192	292

(1) Emission rates for other PSD-regulated pollutants [fluorides, total reduced sulfur, reduced sulfur compounds, and hydrogen sulfide] are negligible.

(2) There are no established lead or H_2SO_4 emission factors for ULSD firing in diesel industrial engines or H_2SO_4 emissions from ULSD or natural gas firing in stationary internal combustion sources.

(3) Higher of the emission rates for natural gas or ULSK firing; values are for each of two turbines.

2.6 Project Potential Annual Emissions

The new source review ("NSR") applicability analysis for the Project emissions is discussed further in Section 3.1.2. Astoria will operate the Project such that the future net VOC and NO_X emissions are below the NNSR triggering thresholds (refer to Section 3.1.2.1).

Potential annual emissions from the proposed Project were estimated using the following assumptions:

- Full-load steady-state operation of the CTG on natural gas for 1,900 hrs/yr[3] (at maximum lb/hr emission rates);
- Limiting ULSD firing in the CTG under all modes of operation to 21.954 million gallons per year ("gal/yr") (equivalent to 720 hrs/yr at maximum load steady-state operation plus SU/SD, based on an ambient temperature of -5°F); annual emissions under steady-state operations based on 720 hrs/yr at maximum lb/hr emission rates;
- 180 and 65 start-up/shutdown cycles per year on natural gas and ULSD, respectively, which is a representative scenario based on the number of steady-state hours for each fuel; and

  Operation of the emergency generator and fire pump engines for 500 hrs/yr.

[3] This is the maximum natural gas operating time at steady-state conditions that results in Project net VOC emissions below the NNSR triggering threshold after accounting for emissions from other operational assumptions as listed. Refer to Section 3.1.2.1 for details.

The two remaining P&W turbines retained for black-start capability will be each limited to 12 hrs/yr operation annually.

Note that natural gas firing can be fired for more than 1,900 hrs/yr provided that ULSD firing is less than the proposed limit of 21.954 million gal/yr, and as long as the Project's VOC and NO_X annual emissions are below the proposed annual limits listed in Section 3.1.2.1 (i.e., 25.40 tons per year ("tpy") for VOC and 97.45 tpy for NO_X on a 12-month rolling basis). Potential annual emissions for the proposed Project, including HAPs, are summarized in Table 2-3. Refer to Appendix C for backup calculations.

Table 2-3 Project and Facility Potential Annual Emissions (tpy)

Pollutant(1)	CTG	Emergency Generator Engine	Fire Pump Engine #1	Fire Pump Engine #2	ULSK Tank	ULSD Tanks	Fugitives (2)	Project Total	Existing P&W Black Start Twin Pac(3)	Facility Total(4)
NO_X	96.60	0.20	0.26	0.39				**97.45**	2.99	**100.44**
VOC	24.82	0.06	0.01	0.01	0.002	0.50		**25.40**	0.006	**25.41**
CO	89.29	1.07	0.32	0.34				**91.02**	1.18	**92.20**
PM	52.47	0.009	0.019	0.02				**52.52**	0.11	**52.63**
PM_{10}	52.47	0.009	0.019	0.02				**52.52**	0.11	**52.63**
$PM_{2.5}$	52.47	0.009	0.019	0.020				**52.52**	0.11	**52.63**
SO_2	7.90	0.002	0.0005	0.0007				**7.90**	0.01	**7.91**
H_2SO_4	5.20	0.0003	0.0001	0.0001				**5.20**	n/a	**5.20**
Pb	0.02							**0.02**	0.00004	**0.02**
GHGs (as CO_{2e})(5)	713,487	204	48	73			2,708	**716,520**	482	**717,002**
Total HAPs	4.52	0.002	0.0011	0.0017	0.0003	0.044		**4.56**	0.006	**4.57**
Formaldehyde (max HAP)	1.99	0.0001	0.0003	0.0005				**1.99**	0.002	**2.00**

(1) Emission rates for other PSD regulated pollutants (fluorides, total reduced sulfur, reduced sulfur compounds, and hydrogen sulfide) are negligible.
(2) Includes SF_6 from onsite electrical circuit breakers and CH_4 from onsite natural gas components (connectors, valves, meters, and regulators)
(3) The emissions listed for the remaining P&W Twin Pac are the total values for both turbines operating for 12 hrs/yr each.
(4) Following construction of the Project.
(5) Based on GWPs consistent with the recent revision to NYCRR 231-13.9, Table 9.

2.7 Construction Schedule

Astoria anticipates that construction of the Replacement Project could commence as early as April 2021, based on the expected timeline for securing the required permit modifications and supplemental State Environmental Quality Review Act ("SEQRA") proceedings. Based on a construction schedule of 25 months (including the shakedown period for the new equipment), the Project would commence operation [which occurs at the end of the Project's shakedown period as defined in 6 NYCRR 231-4.1(b)(12)] in May 2023. Astoria expects that first fire in the CTG could occur as soon as January 2023.

3.0 Regulatory Applicability Evaluation

The Project is subject to both federal and state air regulatory requirements. This section identifies the federal and state regulations that may apply to the proposed Project and discusses how the Project will comply with all applicable requirements.

The regulations reviewed include: NAAQS, NSR (PSD and NNSR), NSPS, NESHAPs, Acid Rain Program requirements; NO_X Budget Program requirements, Section 112(r) Risk Management Program applicability, Title V Operating Permit Program, and additional NYSDEC air regulations.

3.1 Federal Regulations

3.1.1 Ambient Air Quality Standards

The USEPA has developed NAAQS for six air contaminants, known as criteria pollutants, for the protection of public health and welfare. These criteria pollutants are SO_2, PM, nitrogen dioxide (NO_2), CO, O_3, and Pb. PM is characterized according to size; PM having an effective aerodynamic diameter of 10 microns or less is referred to as PM_{10}, or "respirable particulate." PM having an effective aerodynamic diameter of 2.5 microns or less is referred to as $PM_{2.5}$, or "fine particulate"; $PM_{2.5}$ is a subset of PM_{10}. The NYSDEC has adopted the NAAQS.

The NAAQS have been developed for various durations of exposure. The NAAQS for short-term periods (24 hours or less) typically refer to pollutant levels that cannot be exceeded except for a limited number of times per year. The NAAQS for long-term periods refer to pollutant levels that cannot be exceeded for exposures averaged typically over one year. The NAAQS include both "primary" and "secondary" standards. The primary standards are intended to protect human health and the secondary standards are intended to protect the public welfare from any known or anticipated adverse effects associated with the presence of air pollutants.

One of the basic goals of federal and state air pollution regulations is to ensure that ambient air quality, including consideration of background levels and contributions from existing and new sources, is in compliance with the NAAQS. For each criteria pollutant, every area of the United States has been designated as one of the following categories: attainment, unclassifiable, or nonattainment. In areas designated as attainment, the air quality with respect to the pollutant is equal to or better than the NAAQS. In areas designated as unclassifiable, there are limited air quality data, and those areas are treated as attainment areas for regulatory purposes. In areas designated as nonattainment, the air quality with respect to the pollutant is higher than the NAAQS. Nonattainment areas must take actions to improve air quality with respect to the pollutant and achieve attainment with the NAAQS within a certain period of time.

If a new major source or a major modification of an existing major source of air pollution is proposed, it must undergo NSR. There are two programs, one for sources built in attainment/unclassifiable areas, and one for sources in nonattainment areas. The NSR program for sources in attainment/unclassifiable areas is known as the PSD Program. The NSR program for sources being built in nonattainment areas is known as the NNSR Program.

Certain sensitive areas, defined as Class I areas under the Clean Air Act ("CAA"), have a smaller allowable incremental increase in new emissions than Class II and III areas. Areas such as international parks, national parks greater than 6,000 acres, national memorial parks larger than 5,000 acres, and national wilderness areas larger than 5,000 acres are granted Class I status and the highest level of air quality protections under section 162(a) of the CAA. Class II areas are allowed more moderate pollution increases. Class III areas are areas that do not have any air quality standards, and the air quality may be degraded to levels in line with the NAAQS. To date, no Class III areas have been designated; therefore, all areas not established as Class I areas are designated as Class II areas. The closest Class I area relative to the Project is the Brigantine National Wildlife Refuge approximately 150 kilometers ("km") to the south of the Facility in southern New Jersey on the Atlantic Coast (refer to Section 5.14.1 for further discussion).

The Project is located in Astoria, Queens, NY which is designated as attainment/unclassified for all criteria pollutants with the exception of O_3. The area is a serious ozone nonattainment area based on the 2008 1-hour O_3 standard. Thus, all pollutants with the exception of O_3 precursor VOC, are evaluated under the PSD program. NO_X is evaluated under both the PSD program (the area is classified as attainment for nitrogen dioxide, "NO_2") and the NNSR program (since it is also an O_3 precursor compound).

To identify new emission sources with the potential to significantly impact ambient air quality, the USEPA and NYSDEC have adopted significant impact levels ("SILs") for the criteria pollutants. Applicants for new major sources or major modifications of existing major sources are required to perform dispersion modeling analyses to predict air quality impacts of the new or modified sources in comparison to the SILs. If the maximum modeled concentrations of the new or modified sources are less than the SIL for a particular pollutant and averaging period, then the impacts are considered "insignificant" for that pollutant and averaging period. However, if the maximum modeled concentrations of the new or modified sources are greater than the SIL for a particular pollutant and averaging period, then further impact evaluation is required. This additional evaluation must consider measured background levels of pollutants and emissions from both the proposed new sources and existing interactive sources. Further, in areas attaining the NAAQS, air quality is not permitted to degrade beyond specified levels, called PSD increments, as a result of the cumulative impacts of "PSD increment consuming" sources. In general, sources constructed or modified after pollutant and area-specific "baseline dates" consume PSD increment.

Tables 3-1 through 3-3 present the NAAQS, PSD Class II increments as well as the corresponding SILs for the various criteria pollutants and averaging periods. Note that use of the SILs is applicable for this Project for all pollutants and averaging periods because the difference between the NAAQS and the representative ambient background is greater than the SILs. This is discussed in more detail in Section 5.0 of this application which presents a detailed evaluation of the Project's compliance with the applicable ambient air quality standards. Class I SILs and PSD increments applicable to the Project are discussed in Section 5.14.1.

Table 3-1 National Ambient Air Quality Standards

Pollutant	Averaging Period	NAAQS micrograms per cubic meter ("μg/m³")	Form of Design Concentration
CO	1-hour	40,000	Not to be exceeded more than once per year.
	8-hour	10,000	
NO_2	1-hour	188	98th percentile of 1-hour daily maximum concentrations, not to be exceeded as averaged over 3 years.
	Annual	100	Annual mean never to be exceeded.
PM_{10}	24-hour	150	Not to be exceeded more than once per year on average over 3 years.

Pollutant	Averaging Period	NAAQS micrograms per cubic meter ("µg/m³")	Form of Design Concentration
$PM_{2.5}$	24-hour	35	98th percentile, not to be exceeded as averaged over 3 years.
	Annual	12	3-year average never to be exceeded.
SO_2	1-hour	196	99th percentile of 1-hour daily maximum concentrations, not to be exceeded as averaged over 3 years
	3-hour	1,300	Not to be exceeded more than once per year.
Source: 40 CFR 50			

Table 3-2 PSD Class II Increments

Pollutant	Averaging Period	PSD Class II Increments (µg/m³)	Form (Design)
NO_2	Annual	25	Annual mean never to be exceeded.
PM_{10}	24-hour	30	Not to be exceeded more than once per year.
	Annual	17	Annual mean never to be exceeded.
$PM_{2.5}$	24-hour	9	Not to be exceeded more than once per year.
	Annual	4	Annual mean never to be exceeded.
SO_2	3-hour	512	Not to be exceeded more than once per year.
	24-hour	91	Not to be exceeded more than once per year.
	Annual	20	Annual mean never to be exceeded.
Source: Federal Register - Vol 75 - No. 202			

Table 3-3 Class II Significant Impact Levels

Pollutant	Averaging Time (1)				
	Annual µg/m³	24-hour µg/m³	8-hour µg/m³	3-hour µg/m³	1-hour µg/m³
NO_2	1	-	-	-	7.5
CO	-	-	500	-	2000
PM_{10}	1	5	-	-	-
$PM_{2.5}$(2)	0.2	1.2	-	-	-
SO_2	1	5		25	7.8

(1) High 1st high modeled concentration.

(2) USEPA's guidance for $PM_{2.5}$ permit modeling describes the treatment of $PM_{2.5}$ SILs; the guidance is available at http://www.epa.gov/ttn/scram/guidance/guide/Guidance_for_PM25_Permit_Modeling.pdf.

3.1.2 New Source Review

NSR applies to proposed new major sources of air pollutants and major modifications at existing sources. The NSR program for major sources and modifications includes two distinct permitting programs:

- PSD permitting for projects located in areas designated as unclassified or attainment with the NAAQS; and
- NNSR permitting for projects located in areas designated as nonattainment with the NAAQS.

As an area may be in attainment with one or more NAAQS, but in nonattainment with one or more other NAAQS at the same time, an individual project may be subject to both PSD and NNSR permitting depending upon its potential emissions. To comply with the requirements of the Clean Air Act and the major NSR regulations in 40 CFR 51.166 and 40 CFR 51.165, respectively, New York has an USEPA-approved State Implementation Plan ("SIP") in place to implement the PSD and NNSR preconstruction programs. NYSDEC's rules for modifications to existing major sources are in 6 NYCCR Part 231-6 (NNSR) and 6 NYCRR 231-8 (PSD). The existing Astoria facility is a major source with respect to PSD review because the facility's maximum potential emissions for at least one pollutant subject to PSD review exceeds the PSD major source threshold (100 tpy, 100,000 tpy for GHGs). Similarly, the existing Astoria facility is a major source with respect to NNSR because the facility's maximum potential emissions for NO_X exceeds the major source threshold for severe O_3 nonattainment (25 tpy).

A two-step process was followed to determine whether the Replacement Project is subject to PSD review and/or NNSR. The first step compared the Project's maximum potential annual emissions (referred to by the NYSDEC as the project emission potential, or PEP) to the applicable PSD and NNSR significant project thresholds ("SPT"). NYSDEC defines PEP as the sum of the following:

- for new emission sources, the potential to emit of each emission source; and
- for existing emission sources at a major facility, the difference between the baseline actual emissions and the projected actual emissions of the emission source.

Even though the existing ULSK tanks (which will be used to store ULSD for the Project) qualify for use of a netting approach to determine the PEP, only the projected actual emissions were used because baseline emissions for these tanks were very low. The Project's PEP is summarized in Table 3-4.

Pollutants for which the Project's PEP are less than the SPTs are not subject to PSD review or NNSR and no further analysis is required. The second step involved an emissions netting analysis to determine whether the net change in emissions at the Astoria facility exceed the significant net emission increase thresholds ("SNEIT"). This step was followed only for those pollutants for which the Project's PEP exceeded the SPT.

Table 3-5 presents a comparison of the Project's PEP with the applicable NNSR and PSD SPTs.

As summarized in Table 3-5, the Project PEPs exceed the NNSR SPT for NO_X and VOC, and the PSD SPTs for $PM/PM_{10}/PM_{2.5}$; emissions netting was conducted to determine which pollutants are subject to NNSR and/or PSD review. The PEP for GHG is greater than the SPT and netting is not allowed for GHG, so PSD review is required for GHG emissions. Project emissions of CO, SO_2, H_2SO_4, and lead are all below their respective SPTs, and therefore PSD review is not required for those pollutants.

Table 3-4 Replacement Project's PEP (tpy)

Pollutant	New Equipment[1]
NO_X	97.45
VOC	25.40
CO	91.02
PM	52.52
PM_{10}	52.52
$PM_{2.5}$	52.52
SO_2	7.90
H_2SO_4	5.20
Pb	0.02
GHGs	716,520

(1) From Table 2-3. new equipment includes the CTG, emergency generator engine, fire pump engines, ULSD tanks (treated as new units for the purposes of determining PEP), new ULSK tank, and sources contributing to fugitive GHG emissions. Refer to Appendix C for emissions calculations.

Table 3-5 Comparison of Project Potential Emissions (PEP) and Significant Project Thresholds (SPT)

Pollutant	Project PEP[1] (tpy)	NNSR SPT (tpy)	PSD SPT (tpy)	NNSR Potentially Applies? (Yes/No)	PSD Potentially Applies? (Yes/No)
NO_X	97.45	2.5	40	Yes	Yes
VOC	25.40	2.5	40	Yes	No
CO	91.02	N/A	100	*N/A*	No
PM	52.52	N/A	25	*N/A*	Yes
PM_{10}	52.52	N/A	15	*N/A*	Yes
$PM_{2.5}$	52.52	N/A	10	*N/A*	Yes
SO_2	7.90	N/A	40	*N/A*	No
H_2SO_4	5.20	N/A	7	*N/A*	No
Pb	0.02	N/A	0.6	*N/A*	No
GHGs[2]	716,520	N/A	Any increase and 75,000	*N/A*	Yes, PSD Review Applies

(1) See Table 3-4 for PEP summary.

(2) GHGs are expressed as CO_2e. Only represents the SPT for GHG, SNEIT (netting) does not apply for GHG.

6 NYCRR 231-4.1(b)(31) defines a net emission increase as the aggregate increase in emissions of a NSR contaminant at an existing major facility resulting from the sum of:

i. the Project's PEP; and

ii. every creditable emission increase at the facility which is contemporaneous with the Project and for which an emission offset was not obtained; and

iii. any emission reduction credit ("ERC") at the facility, or portion thereof, selected by the applicant which is contemporaneous and which was not previously used as part of an emission offset, an internal offset, or relied upon in the issuance of a permit under this Part.

NYSDEC defines contemporaneous as:

i. the period beginning five years prior to the scheduled commence construction date of the new or modified emission source, and ending with the scheduled commence operation date (applicable to all pollutants except VOC and NO_X for projects located in a severe O_3 nonattainment area); and

ii. five consecutive calendar year period which ends with the calendar year that the proposed modification is scheduled to commence operation (applicable to VOC and NO_X emissions for projects located in a severe O_3 nonattainment area).

For the purposes of this analysis, and as discussed previously in Section 2.7, Astoria estimated that construction of the Project would commence in April 2021 and commencement of operation (after the Project's shakedown period) would be in May 2023. Based on these dates, the contemporaneous period for PSD review is between June 2018 and May 2023, while the contemporaneous period for NNSR is between 2019 and 2023. The existing P&W units (with the exception of the one P&W Twin Pac that will remain to provide black-start capability) will be permanently shut down on or before the completion of the Project's shakedown period. Therefore, the emission decreases associated with the future shutdown of the non-black-start P&W turbines, and limited operation of the two black-start turbines, are contemporaneous with the Project.

Emission Reduction Credits (ERCs) will be generated by the future permanent shutdown of the existing P&W turbines and limited operation of the two remaining P&W turbines as described above. 6 NYCRR 231-10.2(b)(14) defines ERCs as "any decrease in emissions of a nonattainment contaminant, in tpy:

1. which is surplus, quantifiable, permanent, enforceable, and included in a Part 201 permit; and

2. will result from a physical change in, or a change in the method of operation of an emission source subject to Part 201 is quantified as the difference between baseline actual emissions and the subsequent potential to emit and is approved in accordance with the provisions of this part."

6 NYCRR 231-4.1(b)(51) defines surplus as "a reduction in emissions beyond levels prescribed by the most stringent applicable State or Federal emission limitation which is required by the Clean Air Act." Condition 37 of the Facility's Title V permit limits NO_X emissions from the existing P&W turbines to comply with the current NO_X Reasonably Available Control Technology ("RACT") averaging plan. Therefore, the ERCs generated through the future shutdown of turbines, and limited operation of the two remaining turbines, will be surplus to the extent that the NO_X concentrations for the turbines are not greater than 100 ppmvdc. The current System-wide NO_X RACT Compliance Plan stipulates that a NO_X concentration of 100 ppmvdc is equivalent to 0.368 pounds per MMBtu ("lb/MMBtu") based on 40 CFR Part 60, Appendix A, Method 19. Therefore, the NO_X baseline emission rates have been adjusted to reflect this value. There are currently no permit limitations for VOC for the P&W turbines.

A summary of the NNSR and PSD netting analysis is provided in Table 3-6. Backup engineering calculations are provided in **Appendix C**.

Table 3-6 Summary of Nonattainment and PSD Netting Analysis

Compound	Annual Emissions (tpy)						Does NNSR or PSD Review Apply?
	Project Emission Potential(1)	Contemporaneous Changes		Net Emissions Increases(3)	Significant Net Emission Increase Threshold		
		Increases	Decreases(2)		NNSR	PSD	
NO_x	97.45	0	72.55(4)	24.90	25	40	No
VOC	25.40	0	0.5(5)	24.90	25		No
PM	52.52	0	0.0	52.52		25	Yes, PSD
PM_{10}	52.52	0	0.0	52.52		15	Yes, PSD
$PM_{2.5}$	52.52	0	0.0	52.52		10	Yes, PSD

(1) See Table 3-4 of the air permit application.

(2) Emission Reduction Credits from future shutdown of the 22 P&W turbines (prior to completion of the Project's shakedown period) and limited operation of the two remaining P&W turbines retained for black-start capability,. See Appendix C of the Air Permit Application for backup calculations.

(3) Project emissions plus contemporaneous increases minus contemporaneous decreases.

(4) The future shutdown of 22 P&W turbines and limited operation of the 2 remaining P&W turbines retained for black-start capability will result in the generation of 126.04 tpy NOx ERCs; however, the Project only needs 72.55 tpy to net out of NNSR. Applicant will place the remaining NOx ERCs (53.49 tpy) in NYSDEC's ERC Registry.

(5) The future shutdown of 22 P&W turbines and limited operation of the 2 remaining P&W turbines retained for black-start capability will result in the generation of 0.72 tpy VOC ERCs; however, the Project only needs 0.50 tpy to net out of NNSR. Applicant will place the remaining VOC ERCs (0.22 tpy) in NYSDEC's ERC Registry.

3.1.2.1 NNSR Review

The emissions netting analysis summarized in Table 3-6 demonstrates that the Project will not result in a significant net emissions increase for either NO_X or VOC. Therefore, in accordance with 6 NYCRR 231-6.2, Astoria does not need to obtain external emission offsets, does not have to apply the Lowest Achievable Emission Rate ("LAER"), and does not have to submit an alternatives analysis. However, Astoria must include the following as part of the permit application in accordance with Subsection 231-6.2(b):

- an emission limit that equals the potential to emit of the modification of each nonattainment contaminant which exceeds the applicable significant project threshold (this applies to both NOX and VOC for the Project);
- the ERCs relied on for the net emission increase determination;
- a use of ERCs form for each source of ERCs to be used for netting; and
- permit condition(s) that complies with any additional requirements of Subpart 231-11 (Permit and Reasonable Possibility Requirements).

Astoria is proposing federally enforceable emission limits on future annual NO_X and VOC emissions for the Astoria Facility of 100.44 tpy and 25.41 tpy, respectively, on a 12-month rolling basis. These values are the Facility's potentials to emit upon implementation of the Replacement Project and include emissions from the new equipment as well as the P&W black-start Twin Pac.

Astoria is applying for certification of 0.72 tpy of VOC and 126.04 tpy of NO_X ERCs associated with the future shutdown of 22 of the existing P&W turbines and limited operation of the two P&W turbines retained for black start capability. However, the Project will only use 0.50 tpy VOC and 72.55 tpy NO_X of these ERCs to net out of NNSR. The balance of the ERCs generated (0.22 tpy VOC and 53.49 tpy NO_X) will be placed in NYSDEC's ERC Registry to be available for future use by Astoria. The calculation of the allowable baseline emissions and ERC forms are provided with the Title V permit forms in Appendix A.

Permit condition(s) demonstrating how the facility will comply with the applicable requirements of 6 NYCRR 231-11 are provided in the permit forms located in Appendix A.

3.1.2.2 PSD Review

The Project cannot net out and therefore triggers PSD review for $PM/PM_{10}/PM_{2.5}$, and triggers PSD review for GHG. The Project is required to satisfy the following requirements for $PM/PM_{10}/PM_{2.5}$ and GHG:

- Application of BACT controls;
- An ambient air quality modeling analysis demonstrating compliance with NAAQS and PSD increments;
- Additional air quality impact analyses on secondary growth, visibility impairment, soils and vegetation, and other air quality related values at PSD Class I Areas; and
- Demonstration of compliance with EJ requirements.

In addition, as required by 231-8.6(a), Astoria is proposing federally enforceable emission limits on future annual $PM/PM_{10}/PM_{2.5}$ and CO_2e emissions for the Astoria Facility of 52.6 tpy and 717,001 tpy, respectively, on a 12-month rolling basis. These values are the Facility's potentials to emit upon implementation of the Replacement Project and include emissions from the new equipment as well as the P&W black-start Twin Pac. The PSD BACT analysis is provided in Section 4.0. The modeling analysis along with the additional impacts analyses and EJ demonstration are provided in Sections 5 and 6.

3.1.3 New Source Performance Standards

NSPS are technology-based standards applicable to new and modified stationary sources. NSPS have been established for many source categories. Based upon a review of these standards, several subparts are applicable to the proposed Project. The Project's compliance with each of these standards is discussed in the sections below.

3.1.3.1 40 CFR 60 – Subpart A – General Provisions

Any source subject to an applicable standard under 40 CFR 60 is also subject to the general provisions under Subpart A. Because the Project is subject to other Subparts of the regulation, the requirements of Subpart A will also apply. The Project will comply with the applicable notifications, performance testing, recordkeeping and reporting outlined in Subpart A.

3.1.3.2 Subpart Kb - Standards of Performance for Volatile Organic Liquid Storage Vessels After July 23, 1984

This regulation is applicable to storage vessels which have a capacity equal to or greater than 75 m^3 (~19,813 gallons), except the regulation does not apply if the vessel has a capacity greater than 151 m^3 (~39,900 gallons) and stores a liquid with a maximum true vapor pressure less than 3.5 kilopascals ("kPa", ~0.5076 pounds per square inch, "psi").

The two existing ULSK tanks will be used to store ULSD for the Project. Each tank has a capacity of 2,000,000 gallons nominal (~7,571 cubic meters, "m^3") and is much greater than 75 m^3 and 151 m^3, but the true vapor pressure of ULSD is less than 3.5 kPa. Therefore, this regulation is not applicable to the ULSD storage tanks.

The 7,500 gallon ULSK tank which will be brought onsite for the black-start P&W Twin Pac has a maximum capacity of 28.4 m^3, well below the 75 m^3 applicability threshold for this regulation.

The 20,000 gallon 19% ammonia solution tank is not subject to this regulation because ammonia is not an organic liquid.

3.1.3.3 Subpart IIII – Stationary Compression Ignition Internal Combustion Engines

Subpart IIII is applicable to owners and operators of stationary compression ignition ("CI") internal combustion engines that commence operation after July 11, 2005. This regulation applies to the emergency generator engine and the two emergency fire pump diesel engines. All compression ignitions are required to use non-road diesel fuel with a maximum sulfur content of 15 ppmw.

To comply with Subpart IIII, new emergency stationary CI engines with a displacement less than 30 liters per cylinder must meet the emission standards per 40 CFR 60.4205(b). The applicable limits for a 555 kWm new emergency stationary CI engine are USEPA's Tier 2 limits under 40 CFR 89.112; however, the Project will instead use an engine which is certified to USEPA Tier 4 limits as follows:

- 0.67 grams per kilowatt (mechanical)-hour ("g/kWm-hr") NO_X
- 0.19 g/kWm-hr non-methane hydrocarbons ("NMHC", as VOC)
- 3.5 g/kWm-hr CO
- 0.03 g/kWm-hr PM

The Project will install two diesel-fired fire pumps for backup purposes to two electric fire pumps. One diesel engine will be 117 kWm and the other will be 177 kWm. For model year 2010 and later, fire pump engines with a displacement less than 30 liters per cylinder and an energy rating between 75 and 225 kWm, Table 4 of Subpart IIII provides the following emission limits which differ based on the power range the particular engine falls under:

Table 3-7 NSPS Subpart IIII Fire Pump Emission Standards

Maximum Power Range	NMHC + NO_X (g/kWm-hr)	CO (g/kWm-hr)	PM (g/kWm-hr)
75 ≤ kWm < 130	4.0	5.0	0.3
130 ≤ kWm < 225	4.0	3.5	0.2

3.1.3.4 Subpart KKKK – Standards of Performance for Stationary Combustion Turbines

This regulation applies to combustion turbines which begin construction after February 18, 2005.

Subpart KKKK places emission limits on NO_X and SO_2 from new combustion turbines. The proposed CTG will be subject to this standard. For new CTGs with a rated heat input greater than 850 MMBtu/hr, NO_X emissions are limited to the following:

- 15 ppmvdc for natural gas and 42 ppmvdc for oil;

Additionally, SO_2 emissions must meet:

- Emissions limited to 26 nanograms per Joule ("ng/J") (0.060 lb/MMBtu).

As described in Section 2.0, the proposed Project will use DLN combustors and an SCR system to control NO_X emissions to 2.5 ppmvdc during natural gas firing. Water-ULSD emulsion injection and SCR will be used to control NO_X emissions to 5.0 ppmvdc during ULSD firing. A Part 75 continuous emissions monitoring system ("CEMS") system will be used to monitor NO_X emissions. SO_2 emissions will be limited to 0.0015 lb/MMBtu (15 ppmw) when firing both pipeline-quality natural gas and ULSD. As such, the Project will meet the emission limits under Subpart KKKK.

The sulfur content of the fuels used for the new CTG will not require monitoring in accordance with §60.4365(a). A demonstration will be made that the natural gas contains less than 20 grains of sulfur per 100 standard cubic foot ("scf") and the ULSD will contain 15 ppmw sulfur, which is less than the 500 ppmw sulfur threshold that triggers the monitoring requirement.

3.1.3.5 Subpart TTTT – Standards of Performance for Greenhouse Gas Emissions for Electric Generating Units

Subpart TTTT for GHG emissions from electric generating units (including combustion turbines) was promulgated by USEPA and is applicable to the Project. The CTG will be permitted only to burn natural gas and ULSD (No. 1 and/or No. 2 fuel oils). Stationary combustion turbines which are limited to burning fuel with constant chemical compositions only have to maintain purchase records if they are subject to one of the heat input-based standards in Table 2 of the rule. If the unit were to be subject to the generation-based standard, additional requirements would apply.

A natural gas-fired CTG with an annual capacity factor (on a three-year rolling basis) that exceeds the CTG's "design efficiency," expressed as a percent, as defined in the rule, is considered a baseload unit. The applicable standard for baseload combustion turbine is 1,000 pounds (lbs) CO_2/MW-hr gross energy output or 1,030 lbs CO_2/MW-hr net energy output. The "design efficiency" is the rated efficiency of the turbine at International Organization for Standardization ("ISO") conditions, net basis. This value is nominally 40% for an H-class turbine in a simple cycle configuration.

Multi-fuel combustion turbines (< 90% gas firing) and turbines with annual capacity factors less than the "design efficiency" can demonstrate compliance with a mass-based standard, which is expressed in the units of lbs of CO_2 per MMBtu heat input. As the capacity factor of the CTG is expected to qualify for the heat input-based standards, the only requirements under this rule are to maintain purchase records of natural gas and ULSD in accordance with 40 CFR 60.5520(d)(1).

3.1.4 National Emission Standards for Hazardous Air Pollutants (40 CFR Parts 61 and 63)

There are no 40 CFR Part 61 standards applicable to the proposed Project. Current USEPA AP-42 emission factors, other applicable emission factors, and vendor information were reviewed in determining if the proposed Project will be subject to a standard under 40 CFR Part 63. The existing Facility is currently not a major source of HAP emissions and after the Project is completed the Facility will continue to be a non-major, area source of HAP emissions.

3.1.4.1 Subpart YYYY – Stationary Combustion Turbines

Subpart YYYY for Stationary Combustion Turbines is applicable to turbines located at major sources of HAP emissions. Major sources of HAPs have potential emission of a single HAP compound greater than 10 tpy or all HAPs combined greater than 25 tpy. The Facility is not an existing major source of HAP emissions and will remain an area (non-major) source of HAPS after completion of the Project.

3.1.4.2 Subpart ZZZZ – Reciprocating Internal Combustion Engines

The emergency generator diesel engine and emergency diesel fire pump engines are subject to the NESHAPS under 40 CFR 60 Subpart ZZZZ. These NESHAPS generally apply, with the same requirements for new emergency generators, regardless of major or area HAP source status. For new emergency units, the NESHAPS requirements are satisfied if the units comply with the NSPS under 40 CFR 60, Subpart IIII. As stated in Section 4.2.1.4, the Facility will purchase emergency generator and fire pump engines that comply with NSPS Subpart IIII.

3.1.4.3 Subpart UUUUU - National Emission Standards for Hazardous Air Pollutants: Coal- and Oil-Fired Electric Utility Steam Generating Units

The Mercury and Air Toxics ("MATS") rule does not apply to the proposed CTG because it does not produce steam and area source stationary combustion turbines are not subject to the regulation per §63.9983(a).

3.1.5 40 CFR 64 – Compliance Assurance Monitoring ("CAM")

The CAM rule was put into effect to ensure that Title V major sources of emissions have adequate measures in place to assure that control devices operate effectively to comply with emission limits. To be subject to CAM, sources must meet the following three criteria in §642(a)(1)-(3):

1. Be subject to an emission limitation or standard;
2. Use a control device to achieve compliance with the limitation or standard; and
3. Have pre-control emissions greater than the major source threshold.

The only pollutant which has an applicable emission limitation or standard is NO_X. NO_X is subject to NO_X RACT emission standards of 6 NYCRR 227-2 (100 ppmvdc), 6 NYCRR 227-3, NSPS Subpart KKKK [15 (gas) & 42 (oil) ppmvdc]. An SCR will be used to achieve compliance with the emissions standards, and pre-control NO_X emissions are greater than the major source threshold.

However, CAM is not applicable to the proposed CTG because of two exemptions in §62.2(b)(1). One exemption is for emissions limitations which are proposed by USEPA after November 15, 1990 which are pursuant to sections 111 (NSPS standards) or 112 (NESHAP standards) of the Clean Air Act. NSPS Subpart KKKK was promulgated in 2004. The second exemption is for emission limits for which a permit specifies a continuous compliance method. All three of NSPS Subpart KKKK, NO_X RACT, and the ozone season NO_X regulation will all require continuous compliance using NO_X CEMS.

3.1.6 40 CFR Part 72 – Permits Regulation (Acid Rain Program)

Title IV of the Clean Air Act Amendments required USEPA to establish a program to reduce emissions of acid rain forming pollutants, called the Acid Rain Program. The overall goal of this program is to achieve significant environmental benefits through reduction in SO_2 and NO_X emissions. To achieve this goal, the program employs a market-based approach for controlling air pollution. Under the market-based aspect of the program, affected units are allocated SO_2 allowances by the USEPA, which may be used to offset emissions, or traded under the market allowance program. In addition, in order to ensure that facilities do not exceed their allowances, affected units are required to monitor and report their emissions using a CEMS, as approved under 40 CFR Part 75. Emissions and operating data are transmitted to USEPA through the Emissions Collection and Monitoring Plan System ("ECMPS"). The ECMPS system is also used for other regulatory programs.

The Project is subject to the Acid Rain Program based on the provisions of 40 CFR 72.6(a)(3) because the CTG is considered a "utility unit" under the program definition and does not meet the exemptions listed under paragraph (b) of this Section. The Project is submitting a Title IV Acid Rain Permit application along with this Title V modification application. The Acid Rain Permit application is an attachment to the Title V permit forms included In Appendix A.

3.1.7 40 CFR 75 – Continuous Emission Monitoring

Part 75 encompasses USEPA's requirements for CEMS monitoring facilities which are subject to Acid Rain requirements of Part 72. It is also used for other state (Parts 237 or 251) or federal (Cross State Air Pollution Rule, "CSAPR") regulations which require monitoring of NO_X, SO_2, or CO_2. The proposed CTG will be subject to the requirements of Part 75 for monitoring and reporting emissions of NO_X, SO_2, and CO_2.

3.1.8 40 CFR 76 – Acid Rain Nitrogen Oxides Emission Reduction Program

This regulation only specifically applies to coal-fired units. Therefore, it does not apply to the proposed Project.

3.1.9 40 CFR 82 – Protection of Stratospheric Ozone

This regulation implements the Montreal Protocol which was an international agreement to limit the production and use of substances which deplete the ozone layer. Subpart F covers refrigerant recycling and servicing. This regulation is typically included in NYSDEC-issued Title V permits as a generally applicable condition.

3.1.10 40 CFR 89 – Control of Emissions from New and In-Use Nonroad Compression-Ignition Engines

The proposed emergency generator will be subject to the requirements of Part 89, however, this regulation does not impose any specific requirements on engine owners/operators. 40 CFR 60 NSPS Subpart IIII incorporate the requirements of Part 89 for engine manufacturers and include relevant emission standards for certification.

3.1.11 40 CFR 97 – CSAPR Ozone Season NO_X, Annual NO_X, and SO_2 Trading Programs

The Cross-State Air Pollution Rule (CSAPR) requires states to significantly improve air quality by reducing power plant emissions that contribute to ozone and/or fine particle pollution in other states. All three CSAPR trading programs have similar requirements for monitoring and emissions reporting which are performed using Part 75 and ECMPS. These programs have been adopted by NYSDEC and are incorporated as 6 NYCRR Parts 243, 244, and 245.

Annual NO_X trading is contained in Subpart AAAAA. Requirements under this regulation (which similarly also apply to ozone season NO_X and SO_2) include the need to acquire sufficient allowances to equal reporting period emissions.

Ozone Season NO_X has two Subparts BBBBB – Group 1 and EEEEE – Group 2. New York is part of Group 2 and is associated with 21 other states based on the relative downwind impacts on NAAQS attainment. The change to Group 1 and Group 2 was made as part of the CSAPR Update in 2016.

There are three separate SO_2 trading programs broken up geographically by SO_2 impact on downwind states – Subpart CCCCC - Group 1, Subpart DDDDD - Group 2, and Subpart FFFFF - Texas. New York is part of SO_2 Group 1 and may trade amongst Illinois, Indiana, Iowa, Kentucky, Maryland, Michigan, Missouri, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia, and Wisconsin.

3.1.12 40 CFR 98 – Mandatory Greenhouse Gas Reporting

The facility currently reports to USEPA's electronic Greenhouse Gas Reporting Tool ("e-GGRT") annual GHG reporting portal. The Project will be subject to the requirements of Part 98 if the actual GHG emissions from the site are greater than 25,000 tons of CO_2e. The CTG would be subject to the provisions of Subpart D because it will be subject to Acid Rain Program reporting under 40 CFR Part 75. The emergency generator and fire system pump engines are not included in this reporting.

3.1.13 Risk Management Program ("RMP"), Section 112(r)

Title III of the 1990 CAA Amendments contains requirements for subject facilities that store and/or process certain hazardous substances for ensuring their safe use. Under these requirements, facilities must identify and assess their hazards and carry out certain activities designed to reduce the likelihood and severity of accidental chemical releases. Section 112(r) of the CAA, codified in 40 CFR Part 68, mandates the USEPA to publish rules to develop and implement RMPs for sources with more than the threshold quantity of a listed regulated substance to identify, prevent, and minimize the consequences of accidental releases.

The facility will store 19% aqueous ammonia for use in the SCR, and as such the Risk Management Program requirements do not apply to the Project.

3.2 State Requirements

3.2.1 6 NYCRR 201 – Permits and Registrations

The facility's existing Title V Permit will be modified to include the Project sources described in Section 2. The existing facility holds a Title V permit and the Project will be a significant modification. The NYSDEC Title V permit application forms and attachments are located in Appendix A.

3.2.2 6 NYCRR 211 – General Prohibitions

This regulation contains generally applicable requirements to not cause or allow air contaminants which cause a nuisance and limit opacity to 20% with an allowance up to 57%.

3.2.3 6 NYCRR 212 – Process Operations

This regulation applies to process emission sources and process operations to control criteria and toxic air contaminants.

Combustion units are not subject to this regulation because they are specifically exempted in §212-1.4(m). The ULSD and ULSK storage tanks are exempt per §212-1.4(a) because they are exempt units under 201-3.2(21) by having storage capacities less than 300,000 barrels. Fugitive natural gas components and circuit breakers are not subject to this regulation because they do not meet the definition of process operation in §212-1.2(18) because they are not equipped with vents.

3.2.4 6 NYCRR 225 – Fuel Composition and Use

This regulation limits the sulfur content of distillate oils (including kerosene) to 0.0015% sulfur by weight (15 ppmw). Fuel analyses will be collected for each delivery to the facility which may include supplier certifications of ULSD and ULSK sulfur content.

3.2.5 6 NYCRR 227 – Stationary Combustion Installations

This regulation has three subparts which cover particulate matter and opacity limitations, annual NO_X RACT limitations, and ozone season NO_X limitations specific to simple cycle combustion turbines.

3.2.5.1 6 NYCRR 227-1 – Stationary Combustion Installations

Particulate matter is limited to 0.1 lb/MMBtu from new stationary sources greater than 50 MMBtu/hr which fire oil. This limitation only applies to the proposed CTG. All other stationary combustion sources at the Facility that will fire oil are less than 50 MMBtu/hr.

Opacity from stationary combustion sources is limited to 20 percent opacity as a six-minute average, with one period per hour not to exceed 27 percent. Combustion turbines are not required to operate continuous opacity monitoring systems.

3.2.5.2 6 NYCRR 227-2 – RACT for Major Facilities of Oxides of Nitrogen

The existing Astoria site is a major source of NO_X emissions with a potential to emit greater than 25 tpy. Existing simple cycle combustion turbines with a heat input of greater than 10 MMBtu/hr which have been designed to burn distillate oil are limited to a presumptive emission limit of 100 ppmvdc.

The P&W turbines currently comply with the regulation in a system averaging plan with the Arthur Kill facility. The system averaging plan will continue to be used for the remaining P&W Twin Pac for black-start capability.

The CTG will comply with the presumptive NO_X emission limit using SCR and water-ULSD emulsion injection controls and CEMS monitoring.

The emergency generator and two fire system pumps are emergency power generating stationary combustion engines [as defined in 200.6(cq)], and therefore are exempt from the regulation per 227-2(f)(6).

3.2.5.3 6 NYCRR 227-3 – Ozone Season NO_X Emission Limits for Simple Cycle and Regenerative Combustion Turbines

A newly promulgated regulation affects simple cycle combustion turbines which operate during the ozone season. Turbines which have electric generating nameplate capacities of 15 MWe or greater are subject to the regulation. There are two phases of NO_X emission limits required by the regulation. The first phase is effective May 1, 2023 and limits ozone season NO_X emissions to 100 ppmvdc. The second phase begins on May 1, 2025 and limits ozone season NO_X emission based on the fuel fired: 25 ppmvdc when burning natural gas and 42 ppmvdc when firing liquid fuel. The CTG will comply with both phases of emission limit using SCR and water-ULSD emulsion injection controls and CEMS monitoring.

The regulation specifically exempts turbines which are limited to black-start use (with allowance for testing and maintenance). The two P&W turbines to remain will be designated as black-start resources as defined in 227-3.2(1) and will not be subject to the ozone season NO_X emission limits in 227-3. As noted, the two P&W Twin Pac turbines will remain operational to make the site black-start capable until replaced by an approximately 24 MWe BESS.

3.2.6 6 NYCRR 229 – Petroleum and Volatile Organic Liquid Storage and Transfer

The facility will only have the two existing fixed roof ULSK storage tanks (that will be used to store ULSD for the Project) and one new horizontal ULSK storage tank. In the New York City metropolitan area this regulation applies to fixed roof tanks which store liquids with maximum true vapor pressures greater than or equal to 1.0 pounds per square inch absolute ("psia") or to facilities which have the potential to emit VOC greater than 25 tpy (excluding from combustion equipment).

This regulation does not apply to the facility's storage tanks. AP-42 Table 7.1-2 lists the true vapor pressures at 70ºF for both ULSD and ULSK as less than 1.0 psia. The facility potential to emit for VOC is less than 25 tpy when excluding combustion equipment.

This regulation also does not apply to the aqueous ammonia storage tank because it is not an organic liquid.

3.2.7 6 NYCRR 231 New Source Review for New and Modified Facilities

Part 231 encompasses NYSDEC's NNSR and PSD permitting regulations.

3.2.7.1 Subpart 231-6 Modifications to Existing Major Facilities in Nonattainment Areas and Attainment Areas of the State within the Ozone Transport Region

A discussion of NNSR is contained in Section 3.2. As discussed in that section, the Project's potential emissions (PEP) are greater than the significant project threshold for both NO_X and VOC; however, the Project will net out of NNSR for both NO_X and VOC. The baseline period demonstration, ERC quantification, and Use of ERCs information are all attachments to the Title V permit application forms included in Appendix A.

3.2.7.2 6 NYCRR 231-8 – Modifications to Existing Major Facilities in Attainment Areas (Prevention of Significant Deterioration)

A discussion of PSD review is contained in Section 3.2. As discussed in that section, the Project must undergo PSD review for PM, PM_{10}, $PM_{2.5}$, and GHG. The PEP for CO, SO_2, H_2SO_4, and lead are each below the respective significant project thresholds. The required BACT analyses for PM, PM_{10}, $PM_{2.5}$, and GHG is contained in Section 4 and supporting information is provided in Appendix D. The required air quality analysis is contained in Section 5.

3.2.8 6 NYCRR 242 – CO_2 Budget Trading Program

This regulation incorporates the Regional Greenhouse Gas Initiative ("RGGI") into the NYSDEC regulations. This program establishes state-wide CO_2 allowances within the participating states, where applicable sources must obtain CO_2 credits through auctions or from third parties to match CO_2 emissions from fossil-fuel combustion. The program runs on three-year cycles where compliance entities must obtain half of their required credits in each of the first two years, then be in full compliance at the end of the third year. The existing Astoria facility is subject to this regulation and the CTG will also be subject.

3.2.9 6 NYCRR 243/244/245 – CSAPR NO_X Ozone Season Group 2, NO_X Annual, and SO_2 Group 1 Trading Programs

These three regulations collectively comprise the CSPAR regulations, as previously discussed in Section 3.11. All three CSAPR emissions trading programs are applicable to the current facility and will also be applicable to the proposed CTG turbine. As a new unit in the CSAPR programs, the facility will request new unit set-aside allocations for the CTG in accordance with the provisions in 6 NYCRR 243.5; 244.5, and 245.5.

3.2.10 6 NYCRR 251 – CO_2 Performance Standards for Major Electric Generating Facilities

This regulation applies to major electric generating facilities, which are defined in the regulation as having "*an electric generation capacity of at least 25 MW*". The rule limits CO_2 emissions from applicable sources to either a heat input-based limit or an output-based limit using gross electrical output.

The regulation has an effective date for existing sources of December 31, 2020. The existing P&W Twin Pac turbines at the facility will be retained for black-start capability until such time as they are replaced by the BESS. After the Project is constructed, the P&W Twin Pac will be used exclusively for black-start operation and this regulation will not apply because these turbines will not provide electric power to the grid.

The CTG will be subject to the regulation as a new source, subject to a heat input-based emission limit of 160 lb CO_2/MMBtu. This emission limit will apply on a 12-month rolling basis inclusive for both fuels which are fired in the CTG and will be calculated as the sum of CO_2e mass emissions over a 12-month period from natural gas and ULSD firing divided by the total heat input from firing both fuels. Compliance with this limit will be based on Part 75 required monitoring for heat input and fuel flow following Part 75, Appendix D and F and CO_2 mass emissions using CEMS following Part 75, Appendix B and F. Based on the CTG operating scenario described in Section 2.6 (1,900 steady-state hrs/yr firing natural gas, 720 steady-state hrs/yr firing ULSD, and 180 and 65 SU/SD events on natural gas and ULSD, respectively), the annualized CO_2e emission rate will be approximately 130 lb CO_2/MMBtu, which is well below the Part 251 limit.

4.0 Best Available Control Technology (BACT) Analysis

Pollutants subject to PSD review are required to implement BACT as defined by the PSD regulations at 40 CFR 52.21. This BACT analysis was conducted using a top-down approach consistent with PSD BACT requirements.

The Project must install PSD BACT controls for $PM/PM_{10}/PM_{2.5}$ and GHGs. As described in Section 3.1.2, the Project is not subject to BACT or LAER for other pollutants because net emission increases for each pollutant are below the applicable SNEITs.

The following control technology analysis satisfies BACT requirements for $PM/PM_{10}/PM_{2.5}$ and GHGs for the Project. The BACT analysis begins with a description of the overall BACT approach, followed by pollutant-specific sections for each emission source covered by this application. The BACT analysis also reviews the fuels selected for each emission source per NYSDEC definition of BACT, which includes clean fuels.

4.1 BACT Process

NYSDEC regulations define BACT under 6 NYCRR §231-4.1(b)(9) as:

> *"An emissions limitation based on the maximum degree of reduction for each air pollutant subject to regulation under the act which would be emitted from or which results from any proposed major facility or NSR major modification which the department, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable for such proposed major facility or NSR major modification through application of production processes or available methods, systems, and techniques, including fuel cleaning, clean fuels, or treatment or innovative fuel combustion techniques for control of such air pollutant. In no event shall application of BACT result in emissions of any air pollutant which would exceed the emissions allowed by any applicable standard established pursuant to section 7411 or 7412 of the act. Emissions from any source utilizing clean fuels, or any other means, to comply with this paragraph shall not be allowed to increase above levels that would have been required under this paragraph as it existed prior to enactment of the Clean Air Act amendments of 1990."*

In no event shall the application of BACT result in emissions of any pollutant greater than emission standard pursuant to 40 CFR Parts 60 and 61 and the SIP.

The BACT process is described in USEPA's "Top Down BACT Policy"[4] that was further documented in USEPA's draft "New Source Review Workshop Manual, Prevention of Significant Deterioration and Non-attainment Area Permitting"[5] In those documents, the USEPA describes a five-step "top-down" process to identify BACT. This five-step process has been followed to identify BACT for all pollutants subject to the PSD BACT requirement. The top-down BACT process involves the following five-steps:

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[4] Potter, Craig J., Improving New Source Review (NSR) Implementation. December 1, 1987.

[5] New Source Review Workshop Manual (Draft). October 1990. USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711.

(1) identify all control technologies;
(2) eliminate technically infeasible options;
(3) rank remaining control technologies by control effectiveness;
(4) evaluate most effective controls and documents results; and
(5) select BACT.

Following is a description of the steps followed for each BACT-subject pollutant for each emission source.

4.1.1 Step 1: Identification of Control Technology Options

The first step in a BACT analysis is the identification of available control technologies, including an evaluation of transferable and innovative control measures that may not have been previously applied to the source type under analysis. For emission sources with a large number of recent control technology determinations, such as those proposed for the Project, the available control technologies can be identified from the recent agency reviews of these projects. A review was conducted of recent technical determinations made by USEPA and various state air agencies to identify available control technology options for each proposed emission source and each subject pollutant.

4.1.2 Step 2: Identification of Technically Infeasible Control Technology Options

Once all control technology options are identified, each is evaluated to determine if it is technically feasible for the proposed emission source. This determination is made on a case-by-case basis in accordance with regulatory guidance. A control option may be shown to be technically infeasible by documenting that technical difficulties would preclude the successful use of the control option on the emissions unit under review. Per regulatory guidance, a permit requiring the application of a technology is sufficient justification to presume the technical feasibility of that technology. Following this guidance, this analysis has focused on technologies that have been demonstrated in practice based upon recent determinations and reviewed alternative technologies to assess their capability to achieve a greater emission reduction than the approved technologies.

4.1.3 Step 3: Ranking of Technically Feasible Control Technology Options

After technically infeasible control technologies have been eliminated, the remaining control options are ranked by control effectiveness. The minimum requirement for a BACT proposal is an option that meets federal NSPS limits or other minimum state or local requirements, such as NYSDEC emission standards.

4.1.4 Step 4: Evaluation of Most Effective Controls

The USEPA's draft NSR Manual states that:

> *"if the applicant accepts the top alternative in the listing as BACT, the applicant proceeds to consider whether impacts of unregulated air pollutants or impacts in other media would justify selection of an alternative control option. If there are no outstanding issues regarding collateral environmental impacts, the analysis is ended and the results proposed as BACT. In the event that the top candidate is shown to be inappropriate, due to energy, environmental, or economic impacts, the rationale for this finding should be documented for the public record. Then the next most stringent alternative in the listing becomes the new control candidate and is similarly evaluated. This process continues until the technology under consideration cannot be eliminated by any source-specific environmental, energy, or economic impacts which demonstrate that alternative to be inappropriate as BACT."*

USEPA's guidance document "PSD and Title V Permitting Guidance for Greenhouse Gases" [6] states that

> *"the top-ranked option should be established as BACT unless the permit applicant demonstrates to the satisfaction of the permitting authority that technical considerations, or energy, environmental, or economic impacts justify a conclusion that the top-ranked technology is not 'achievable' in that case."*

Accordingly, an evaluation of energy, environmental, or economic impacts is applied only when an applicant intends to demonstrate that the top ranked option is not achievable.

Based upon this guidance, when the top-case BACT option was determined to be achievable and was selected for the Project, an evaluation of energy, environmental, or economic impacts was generally not considered. The exception to this is that any collateral environmental impacts associated with a proposed top-case option were addressed only to the extent that such collateral impacts would be deemed unacceptable, and thus rule out a proposed top-case option as BACT.

Per USEPA guidance, BACT is expressed as an emission rate and the top level of control is determined from the following:

- The most stringent emissions limitation which is contained in any SIP for such class or category of stationary source; or
- The most stringent emissions limitation which is achieved in practice by such class or category of stationary source.

In order to identify the "most stringent emissions limitation which is achieved in practice" by a simple cycle CTG facility, numerous sources of information were evaluated, including the following:

- USEPA's RACT/BACT/LAER Clearinghouse ("RBLC");
- The California Air Resources Board ("CARB") BACT Clearinghouse;
- USEPA regional air permitting websites; and
- State environmental agency websites.

In addition to these sources of information, additional publicly available information such as permits for individual projects not listed in the RBLC or agency websites, were also included in the analysis.

Information was compiled for each emission source, focusing on projects permitted in the last five years. Older precedents were included on a pollutant-specific basis to identify the most stringent permitted emission levels achieved in practice on a pollutant-by-pollutant basis. Appendix D provides the BACT precedents identified for comparable simple cycle CTG projects.

4.1.5 Step 5: Selection of BACT

If there is only a single technically feasible option, or if the top-ranked control option is proposed, then no further analysis was conducted other than a check of potentially unacceptable collateral environmental impacts as discussed above. If two or more technically feasible options were identified, and the most stringent (top) level of control was not proposed, the next three steps (as presented below)

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[6] "PSD and Title V Permitting Guidance for Greenhouse Gases." USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711. November 2011.

were applied to demonstrate that the economic, energy, and environmental impacts of the top-ranked option justified not selecting this option as BACT.

Economic Impacts

The economic analysis consists of evaluating the cost-effectiveness of a control technology, on a dollar per ton of pollution removed basis. Annual emissions with a control option are subtracted from base-case emissions to calculate tons of pollutant controlled. The base case may be uncontrolled emissions, or the maximum emission rate allowed by regulation (such as an NSPS limit). Annual costs are calculated by the sum of operation and maintenance costs plus the annualized capital cost of the control option. Operating and maintenance costs may take into account a reduction in the output capacity or reliability of a unit. The cost-effectiveness (dollars per ton of pollutant removed) of a control option is the annual cost (dollars per year) divided by the annual reduction in pollutant emissions (tpy). If the calculated cost effectiveness is deemed too high, then a control option may be eliminated from the remainder of the BACT analysis for economic reasons. If the most effective control option is proposed, or if there are no technically feasible control options, an economic analysis is not required.

Energy Impacts

The consumption of energy by the control option itself is a quantifiable energy impact that can be quantified by either an increase in fuel consumption due to reduced efficiency or fuel consumption to power the control equipment.

Environmental Impacts

The environmental impact analysis concentrates on other impacts such as solid or hazardous waste generation, discharges of polluted water from a control device, visibility impacts, or emissions of additional pollutants. Collateral increases or decreases in air pollutant emissions of other criteria or non-criteria pollutants may occur with a control option and should be evaluated. These additional impacts are identified and qualitatively and/or quantitatively evaluated, as appropriate.

4.2 Combustion Turbine BACT

4.2.1 Fuels

The first step in evaluating BACT is to evaluate changes in raw materials where substitution to a lower emitting raw material may be technically feasible. For the Project, the “raw material” would be the fuel combusted in the CTG. The selection of the lowest emitting fuel for a combustion source affects emissions of multiple pollutants and, therefore, this review of available fuels is applicable for all BACT-subject pollutants for the Project.

4.2.1.1 Step 1: Identification of Control Technology Options

Available fuel choices for the CTG include the following:

- Hydrogen
- natural gas as the sole fuel, based on securing a dedicated pipeline supply;
- natural gas as the primary fuel with liquefied natural gas (“LNG”) as backup; and
- natural gas as the primary fuel with limited ULSD.

4.2.1.2 Step 2: Identification of Technically Infeasible Control Technology Options

Hydrogen was considered as a potential fuel source for the Project. While the use of hydrogen fuel blended with natural gas has been demonstrated for use in combustion turbines[7], the fuel is not commercially available to serve the Project at this time. Use of hydrogen fuel by the Project would require (i) the commercial production of sufficient quantities of the fuel (about 12,500 mcf/hour) and (ii) the ability to deliver the required fuel quantities to the Astoria Facility via existing natural gas pipeline infrastructure. However, according to a recent report by the International Renewable Energy Agency, "The vast majority of hydrogen today is produced and used on-site in industry." In addition, "development of hydrogen infrastructure is a challenge and holding back widespread adoption. New and upgraded pipelines and economic shipping solutions require further development and deployment."[8] .

Therefore, while holding considerable future promise, hydrogen is considered to be a technically infeasible fuel choice for the Project's CTG.

Natural gas is the cleanest burning fossil fuel and its selection as the primary fuel is the "top case" for emissions reductions that may be achieved through fuel choice. The design of the Project as a reliability resource providing on-demand peaking power in the NYISO control area requires it to be capable of qualifying as both a 10-minute Non-Synchronized Reserve ("TMNSR") asset (i.e., able to start and reach full load within 10 minutes) and a 30-minute Non-Synchronized Reserve asset (i.e., able to start and reach full load within 30 minutes). Such service requires a source of fuel be available at all times ("No Notice Service"). The Facility currently connects to the natural gas system of Con Edison (the Local Distribution Company or "LDC") and has access to non-firm (interruptible) No Notice Service. However, the LDC's system is highly constrained in the New York City area and cannot always support the quick start requirements of the Project without affecting other firm customers. In addition, in the winter when gas demand is high, supply to the Facility is subject to periodic Operational Flow Orders ("OFO"), which curtail supply to non-firm customers. Accordingly, whenever Con Edison determines the existing system cannot reliably supply sufficient natural gas to support the Project, an alternative fuel supply will be required.

The Project's fundamental purpose as a source of peaking power when electric supplies are needed most by the regional transmission system eliminates the option of relying solely on interruptible gas as a fuel supply for the CTG. This conclusion is supported by the findings in the NYISO's November 2019 Final Report on Fuel and Energy Security in New York State[9]:

> **Dual fuel capability - with oil as a backup fuel to natural gas - is vital for maintaining reliability.** Taking into consideration the demand for natural gas by LDCs for serving retail needs, there simply is not enough gas available for power generation downstate under prolonged, severe cold winter conditions to ensure reliable operations, absent the ability of dual-fuel units to switch fuels. While these resources may operate economically - and to the advantage of electricity consumers - most of the year on available non-firm supplies of natural gas, under severe cold weather conditions LDC demand and other firm natural gas transportation commitments (including for deliveries to neighboring regions) reduce available natural gas for power generation to levels below that needed for reliable system operations, absent the ability to switch to oil.

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[7] https://www.ge.com/power/gas/fuel-capability/hydrogen-fueled-gas-turbines

[8] Hydrogen: A Renewable Energy Perspective September 2019 by the International Renewable Energy Agency (https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/Sep/IRENA_Hydrogen_2019.pdf)

[9]https://www.nyiso.com/documents/20142/9312827/Analysis%20Group%20Fuel%20Security%20Final%20Report%2020191111%20Text.pdf/cbecabaf-806b-d554-ad32-12cfd5a86d9e

> Maintaining adequate dual fuel and other oil-fired operating capability is critical to reliable operations during adverse winter conditions, especially in the downstate region.

Since the Project could not fulfill its central function as a backstop for regional power supplies if it could only operate on non-firm gas, using interruptible gas as the sole fuel was deemed infeasible and eliminated as an option for the Project.

Securing dedicated capacity on the natural gas pipelines for the Facility (i.e., a firm supply) is also not feasible for the Project since it would require major regional infrastructure system improvements. As demonstrated by recent natural gas expansion projects proposed for New York[10], such infrastructure improvements are not consistent with state energy policy goals and could not be readily permitted. Therefore, interstate pipeline upgrades were deemed technically infeasible for purposes of BACT for cleaner fuels.

Another potential option that would create a firm supply of natural gas to the Project would be the use of LNG storage. Con Edison does operate an LNG storage facility proximate to the Project. However, this facility is already fully utilized to serve other Con Edison natural gas customers and no storage capacity is available for the Project. Securing the necessary approvals for and constructing a dedicated LNG storage facility at the Astoria site is also not feasible. A significant concern is the safety exclusion zone required around LNG storage tanks. The existing Facility does not have sufficient space for such an exclusion zone. Moreover, a new LNG storage facility would likely be considered an expansion of existing natural gas infrastructure and run into the same energy policy challenges discussed above. Therefore, using LNG as a backup to pipeline natural gas is eliminated as technically infeasible for the Project, which similarly renders natural gas as a sole fuel source for the Project infeasible for purposes of BACT.

Therefore, given a firm source of fuel is essential for the Project to provide reliable backup electric generating service at all times, the cleanest remaining technically feasible option is the use of interruptible natural gas as the primary fuel with limited use of ULSD. The need for ULSD as a fuel supply is further supported by the latest Bulk Electric System Transmission Planning Criteria from Con Edison[11]:

Principle 13: New or re-powered generating projects proposing to interconnect to the Con Edison gas transmission system shall be designed, constructed, operated and tested in each Capability Period so that they can automatically switch fuel from natural gas to liquid fuel whenever experiencing low system gas pressure or a loss of gas condition. Automatic switching shall occur at any dispatch level within 45 seconds of experiencing low gas pressure. The generators shall remain synchronized and return to their pre-gas disturbance dispatch levels in accordance with their ramp-rate. The new generation shall have the equipment required to perform fuel switching. The project shall ensure that such automatic fuel switching capability is operational as of the commercial operation date of the project.

The Project will be designed with automatic fuel switching capability as required by Principle 13.

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[10] https://www.dec.ny.gov/permits/115980.html;
https://content.govdelivery.com/accounts/NYSDEC/bulletins/144fb0f

[11] TP-7100-15, https://www.coned.com/-/media/files/coned/documents/business-partners/transmission-planning/transmission-planning-criteria-2017.pdf?la=es ;!!BJC6uDBu-zY!Z06y75gZqOEWKIC2QJnrYa5kINYOIXFf1-iqkQs9q5IiGqTLo8VIS6tlNULIc4-M$

4.2.1.3 Step 3: Ranking of Technically Feasible Control Technology Options

The sole technically feasible option for fuels is natural gas as the primary fuel with limited use of ULSD.

4.2.1.4 Step 4: Evaluation of Most Effective Controls

Limits achieved in practice for generating units that utilize ULSD include limiting the number of annual operating hours or limiting the amount of ULSD that can be fired (gal/yr). The Title V Permits for the neighboring Astoria Energy facility and New York Power Authority ("NYPA") Poletti Project contain limits on the amount of ULSD that can be fired in the CTGs (41.6448 million gal/yr for Astoria Energy and 21.8 million gal/yr for NYPA). More recently, the May 29, 2019 draft Title V permit for the CPV Valley Energy Facility located in Middletown, NY limits the annual ULSD firing rate to 22,100,000 gal/yr on a 12-month rolling basis.

4.2.1.5 Step 5: Selection of BACT

The proposed fuel BACT for the Project is the use of natural gas as the primary fuel with limited use of ULSD. The selection of appropriate conditions on ULSD use is key to the fuels BACT determination.

In order to ensure reliable annual service to the region as a peaking power resource, the Project is requesting an annual ULSD throughput limit of 21.954 million gal/yr which is equivalent to 720 hrs/yr of steady-state operation using ULSD plus a reasonable allocation for startup, shutdown and fuel switching. This annual ULSD limit is consistent with ULSD restrictions at CPV Valley and the nearby Astoria Energy and NYPA Poletti Power Projects.

There are no unacceptable adverse collateral negative environmental impacts (e.g., dispersion modeling indicates Project impacts less than the SILs) associated with use of up to 21.954 million gal/yr of ULSD firing that would preclude its selection as BACT, in combination with use of natural gas as the primary fuel.

4.2.2 PM/PM_{10}/$PM_{2.5}$

4.2.2.1 Step 1: Identification of Control Technology Options

Process Modifications

The process is the proposed simple cycle CTG; CTGs have inherently low PM emission rates when firing low sulfur fuels. Emissions of PM from combustion can occur as a result of trace inert solids contained in the fuel and products of incomplete combustion, which may agglomerate or condense to form particles. PM emissions from CTGs equipped with SCR can also result from the formation of ammonium salts due to the conversion of SO_2 to sulfur trioxide ("SO_3"), which is then available to react with NH_3 to form ammonium sulfates. All PM emitted from the proposed simple cycle CTG is conservatively assumed to be less than 2.5 microns in diameter. Therefore, PM, PM_{10} and $PM_{2.5}$ emission rates are assumed to be the same.

Add-on Controls

This evaluation did not identify any PM/PM_{10}/$PM_{2.5}$ post-combustion control technologies available for simple cycle combustion turbines. Post-combustion particulate control technologies such as fabric filters (baghouses), electrostatic precipitators, and/or wet scrubbers, which are commonly used on solid-fuel boilers, are not available for combustion turbines since the large amount of excess air inherent to combustion turbine technology would create an unacceptable amount of backpressure for combustion turbine operation. There are no known simple cycle combustion turbine facilities that are equipped with a post-combustion particulate control technology.

4.2.2.2 Step 2: Identification of Technically Infeasible Control Technology Options

The only known control option for particulate matter from combustion turbines is to fire clean-burning low-sulfur fuels and ensure good combustion practices.

4.2.2.3 Step 3: Ranking of Technically Feasible Control Technology Options

The firing of natural gas as the primary fuel, limited firing of ULSD, and good combustion practices are the only technically feasible controls.

4.2.2.4 Step 4: Evaluation of Most Effective Controls

The results of the search of the RBLC and other available permits for PM/PM_{10}/$PM_{2.5}$ BACT/LAER precedents are presented in Table D-1 in Appendix D. Based on this search, use of clean-burning fuels and state-of-the-art combustion practices are the most stringent available technologies for control of simple cycle combustion turbine PM emissions.

A review of Table D-1 indicates that the majority of the limits are presented in the units of lb/hr. In order to compare these limits across a range of turbine sizes, the equivalent full-load emission rates in lb/MMBtu were estimated for each turbine based on available data.

The natural gas-fired limits in lb/hr equate to a range from 0.003 – 0.040 lb/MMBtu when converted to lb/MMBtu at base load, with the bulk of the limits in the 0.005 – 0.012 lb/MMBtu range. Since most of these limits are expressed in lb/hr, the equivalent lb/MMBtu would increase under part-load conditions. The NRG Canal 3 project equipped with a GE 7HA.02 was approved by Massachusetts Department of Environmental Protection ("DEP") in September 2017 with limits of 0.0073 lb/MMBtu at or above 75% load and 0.012 lb/MMBtu below 75% load.

For oil fired units, there are a number of simple cycle turbine projects listed in Table D-1 with BACT determinations with limits ranging from 0.012 - 0.046 lb/MMBtu. Most oil-fired limits are near 0.03 lb/MMBtu, which would be consistent with full load operation. The most recent oil-fired project is the NRG Canal 3 project with limits of 0.026 lb/MMBtu at or above 75% load and 0.046 lb/MMBtu below 75% load. The most stringent oil-fired limit of 0.012 lb/MMBtu is for Montpelier Generating which is based on the use of recent Pratt and Whitney Twin Pac aeroderivative gas turbines (a newer Twin Pac model than the turbines which are being retired at Astoria), not a large frame turbine like the GE 7HA.03 that will be used for the Project. A second very low emission limit is 0.020 lb/MMBtu for Nelson Generating (GE 7FA). However, the Nelson Generating project was never constructed. Therefore, this emission limit has not been demonstrated in practice.

There are differences in PM/PM_{10}/$PM_{2.5}$ emission limits among various projects that are largely due to different emission guarantee philosophies of the various Original Equipment Manufacturers and are not believed to be actual differences in the quantity of PM/PM_{10}/$PM_{2.5}$ emissions inherently produced by the combustion turbine models. The different emission guarantee philosophies are influenced by the overall uncertainties of the PM/PM_{10}/$PM_{2.5}$ test procedures, especially given reported difficulties in achieving test repeatability, and concerns with artifact emissions introduced by the inclusion of condensable particulate emissions in permit limits in the last decade.

A review of emission limits in SIPs did not identify any PM/PM_{10}/$PM_{2.5}$ emission limits for combustion turbines more stringent than limits achieved in practice by recently permitted and operated simple cycle CTGs subject to BACT and/or LAER requirements.

4.2.2.5 Step 5: Selection of BACT

Astoria is proposing the PM/PM_{10}/$PM_{2.5}$ BACT emission rate to be the CTG Original Equipment Manufacturer performance emissions guarantees, consistent with other permitted projects. As there are no GE HA.03 CTGs currently operating in simple cycle configuration, there are no comparable projects to assess limits that have been demonstrated in practice for these proposed BACT limits.

For natural gas firing, the proposed $PM/PM_{10}/PM_{2.5}$ emission rates at loads equal to or greater than 75% are 23.2 lb/hr and 0.0082 lb/MMBtu. At loads below 75%, the proposed $PM/PM_{10}/PM_{2.5}$ emission rates at loads less than 75% are 19.2 lb/hr and 0.0097 lb/MMBtu

For ULSD firing, the proposed $PM/PM_{10}/PM_{2.5}$ emission rates at loads equal to or greater than 75% are 71.1 lb/hr and 0.025 lb/MMBtu. At loads below 75%, the proposed $PM/PM_{10}/PM_{2.5}$ emission rates are 68.7 lb/hr and 0.032 lb/MMBtu

These limits will address all steady-state operating loads for the CTG, providing limits for both peak load (lb/hr) and MECL (lb/MMBtu). These values are within the range of PM BACT precedents in Table D-1 in Appendix D.

The proposed controls represent the top level of control and have been demonstrated to be achievable in practice. Pursuant to USEPA and NYSDEC guidance, an evaluation of economic and energy impacts has not been conducted. There are no unacceptable collateral environmental impacts associated with the proposed $PM/PM_{10}/PM_{2.5}$ BACT.

4.2.3 GHGs

4.2.3.1 Step 1: Identification of Control Technology Options

The GHGs associated with fuel combustion in the CTG for the Project are CO_2, CH_4, and nitrous oxide ("N_2O"). Because these gases differ in their ability to trap heat, 1 ton of CO_2 in the atmosphere has a different effect on global warming than 1 ton of CH_4 or 1 ton of N_2O. For example, CH_4 and N_2O have 25 times and 298 times the global warming potential of CO_2, respectively, using the proposed values from 231-13.9, Table 9 as described in Section 2.5. GHG emissions from the Project are primarily attributable to combustion of fuels in the simple cycle combustion turbine. By far the greatest proportion of potential GHGs emissions associated with the Project are CO_2 emissions associated with combustion of natural gas and ULSD in the CTG. Trace amounts of CH_4 and N_2O will be emitted during combustion in varying quantities depending on operating conditions. After adjusting for global warming potential by converting GHG emissions of N_2O and CH_4 to CO2e, emissions of CH_4 and N_2O are less than 0.5% of the CO_2 emissions from the CTG. As such, BACT for the turbine focuses on the options for reducing and controlling emissions of CO_2.

Process Modifications

CO_2 is a product of combusting any carbon-containing fuel, including natural gas and ULSD. All fossil fuel contains significant amounts of carbon. During complete combustion, carbon in the fuel is oxidized into CO_2 via the following reaction:

Fuel $C + O_2 \rightarrow CO_2$

Recent BACT determinations for simple cycle CTG projects have focused on reducing emissions of CO_2 through high efficiency power generation technology and use of cleaner-burning fuels. Because emissions of CO_2 are directly related to the amount of fuel combusted, an effective means of reducing GHG emissions is through efficient power generation combustion technologies. By utilizing more efficient technology, less fuel is required to produce the same amount of output electricity. The Project is proposing to use an H-class combustion turbine, which is the most efficient combustion turbine in its size range that is commercially available. The Project will have a "Design Base Heat Rate" (new and clean) of approximately 8,955 Btu/kW-hr (gross, HHV), while firing natural gas at full load at ISO conditions, evaporative cooler off. While firing ULSD, this "Design Base Heat Rate" (new and clean) is

9,243 Btu/kW- hr (gross, HHV). The emphasis on GHG reductions via efficient combustion is reflected in the recently issued BACT determinations for similar simple cycle CTG projects as summarized in Table D-2 in Appendix D.

Combined cycle technology can also be considered a type of "process modification," albeit a process modification that changes the fundamental nature of the Project. With combined cycle technology, a heat recovery steam generator is installed and waste heat is recovered from the exhaust gas in the form of steam. This steam is then directed to a steam turbine, which is then used to generate additional power. This increases the efficiency of power generation per unit of fuel combusted. A cooling technology (normally either air cooled condensers or wet cooling towers for new facilities) must also be incorporated to condense the steam as part of the combined cycle process. However, as discussed below, converting this Project to combined cycle would change the fundamental nature of the Project, and is not technically feasible for the Project to serve its design function as a faststarting, quick ramping 10 minute Non-Synchronous Reserve peaking unit because combined cycle units do not support this operating profile.

Another effective method used to reduce GHG emissions is the use of inherently low-emitting fuels. The Project's simple cycle CTG will combust natural gas as the primary fuel, which is the lowest GHG emitting fossil fuel. Firing of ULSD will be limited to no more than 21.954 million gal/yr, the equivalent of 720 hrs/yr of steady-state operation plus a reasonable allocation for startup, shutdown and fuel switching per rolling 12-month period pursuant to the restrictions defined in the Fuels BACT analysis.

Add-on Controls

There are limited post-combustion options for controlling CO_2. The USEPA has indicated in the document, *PSD and Title V Permitting Guidance for Greenhouse Gases,* that carbon capture and sequestration ("CCS") should be considered in BACT analyses as a technically feasible add-on control option for CO_2.[12] Currently, there are no CTG projects utilizing CCS, and although theoretically feasible, this technology is not commercially available. However, this control option is discussed in greater detail below.

CCS requires three distinct processes:

- isolation of CO_2 from the waste gas stream;
- transportation of the captured CO_2 to a suitable storage location; and
- safe and secure storage of the captured and delivered CO_2.

The first step in the CCS process is capture of the CO_2 from the process in a form that is suitable for transport. There are several methods that may be used for capturing CO_2 from gas streams, including chemical and physical absorption, cryogenic separation, and membrane separation. Exhaust streams from simple cycle combustion turbines have relatively low CO_2 concentrations. Only physical and chemical absorption would be considered technically feasible for a high-volume, low-concentration exhaust gas stream.

The next step in the CCS process is transportation of the captured CO_2 to a suitable storage location. Currently, development of commercially available CO_2 storage sites is in its infancy. The nearest geological formation that has the potential capability of storing CO_2 are depleted natural gas reservoirs in Western New York or offshore southeast of southern New Jersey beneath the Continental Shelf. Each of these locations are more than 150 miles from the Project. Moreover, viable carbon storage

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[12] PSD AND TITLE V PERMITTING GUIDANCE FOR GREENHOUSE GASES, USEPA. March 2011.

facilities currently do not exist in these regions. New York and New Jersey are areas where the suitability of geological formations for CO_2 storage is being studied by the Midwest Regional Carbon Sequestration Partnership ("MRCSP"), which is funded by the Department of Energy. While several CO_2 sequestration demonstrations have been initiated under this program, much further development is needed before a commercially available CO_2 sequestration site becomes available near the Project. Currently, the closest MRCSP CO_2 sequestration site in the development phase is in northern Michigan, over 700 miles from the Project site by land, through Canada and across Lake Huron.[13]

4.2.3.2 Step 2: Identification of Technically Infeasible Control Technology Options

Converting the Project to combined cycle technology is not feasible to allow the Project to serve its design function as a quick start, fast ramping TMNSR peaking unit. A simple cycle peaking turbine is not the same "source type" as a conventional combined cycle unit for BACT purposes. A conventional combined-cycle unit has longer start-up times and ramp-up rates and is disadvantaged as a TMNSR resource due to the need to warm up the steam-related combined-cycle components. Therefore, conventional combined-cycle technology has been determined to be technically infeasible for the Project since it changes the fundamental nature of the Project to a different source type and would prevent the Project from providing its full output as TMNSR. USEPA top-down BACT guidance and a USEPA Environmental Appeals Board ("EAB") decision both recognize the fundamental difference between simple cycle and combined-cycle turbines for the purposes of BACT determinations. The USEPA's draft "New Source Review Workshop Manual, Prevention of Significant Deterioration and Nonattainment Area Permitting" contains the following passage at Page B.61 when presenting a sample BACT analysis:

"Due to the lag time required to bring a heat recovery steam generator on line, it is not technically feasible to use a HRSG at the facility. Use of an HRSG in this instance was shown to interfere with the performance of the unit for peaking service, which requires immediate response times for the turbine."

In addition, the EAB Decision in the matter of the Pio Pico Energy Center (PSD Permit No. SD 11-01, PSD Appeal Nos. 12-04 through 12-06, decided August 2, 2013) addressed (among other matters) a challenge that USEPA Region IX erred in eliminating combined cycle combustion turbines in Step 2 of its BACT analysis for greenhouse gases, or that the issue otherwise warrants review or remand. In particular, the EAB concluded that the Region did not define "source type" too narrowly in Step 2 and that USEPA's elimination of combined cycle turbines was consistent with BACT. Therefore, this EAB finding and historical USEPA BACT guidance supports the fact that simple cycle and conventional combined cycle units are fundamentally different source types for purposes of BACT determinations, and conventional combined cycle technology may be eliminated at Step 2 for a simple cycle project.

It is recognized that new "quick-start" combined cycle technologies have been developed (also known as "flex plants") that will allow a certain portion of the combustion turbine output to be available in 10 minutes from initial start-up, while the steam-cycle portion of the combined cycle unit warms up. However, in order to be able to bring more than 400 MWe to the grid in 10 minutes, the total size of the quick-start combined cycle plant would need to be larger than 600 MWe. More than two F-class turbines would be needed to accomplish the same level of 10-Minute Non-Synchronized Reserves. In addition to being substantially larger and more expensive than a single H class simple cycle unit, such a two-unit combined cycle plant would still operate in a fundamentally different manner.

A single quick-start F-class combined cycle unit would have a nominal output of 300 MWe, but would only be able to provide approximately 150 MWe in 10 minutes. The single F-class "quick-start" combined

[13] https://www.mrcsp.org/michigan-basin-site---development-pha

cycle unit would cost substantially more than the proposed H-class simple cycle unit but would provide less than half as much power in 10 minutes.

Furthermore, even quick start combined cycle units have fundamental design limitations for providing 10 Minute Non-Synchronized Reserves. TMNSR resources are typically dispatched in response to large system contingencies (e.g., an unexpected outage of a major generator or transmission line). In accordance with Northeast Power Coordinating Council ("NPCC") and New York State Reliability Council ("NYSRC") requirements, the NYISO maintains 1,310 MWs[14] of total 10 Minute reserves (Snchronized + Non-Synchronized) at all times. Of this amount 870 MWe must be TMNSR in the East (Load Zones F-K). An additional 1,200 MWs of 30-Minute Reserves is required in Load Zones F-K as well.

Typically, one of the first actions the NYISO takes after unexpectedly losing a large generator or transmission line is to start up its TMNSR resources. At the same time, the NYISO also starts up 30 Minute Reserve resources. As soon as sufficient 30 minute resources are reliably on line, the NYISO often shuts down (restores) the 10 minute Non-Synchronous resources to reconfigure the system should the next largest contingency occur. In practice, this means that 10 minute Non-Synchronous resources are commonly dispatched for one hour or less. In fact, this is precisely why the NYISO requires all Non-Synchronous reserve resources to have a minimum run time of no more than one hour. The proposed Project has been specifically designed to meet these criteria. It can start up and reach full load within 10 minutes, run for one hour, shut back down and then be ready to restart again in less than one hour. On the other hand, combined cycle units typically have minimum run times of 4 hours or greater.

Consequently, two "quick-start" F-class combined cycle units are considered commercially infeasible since they would represent fundamental project changes, there is insufficient space available at the Project site, they have significantly higher costs and ultimately do not provide sufficient TMNSR capability.

With respect to the technical feasibility of CCS, there are no simple cycle combustion turbine facilities utilizing CCS and this technology is not considered commercially available. As such, this technology has not been demonstrated in practice for any simple cycle power generating facility in the United States. However, for the purposes of this analysis, CCS will be considered technically feasible in accordance with USEPA guidance.

4.2.3.3 Step 3: Ranking of Technically Feasible Control Technology Options

The technically feasible options, ranked in order or effectiveness and achievability, are as follows:

- CCS;
- low emitting fuels; and
- generating efficiency.

4.2.3.4 Step 4: Evaluation of Most Effective Controls

The results of the search of the RBLC and other available permits for GHG BACT precedents are presented in Table D-2 in Appendix D. GHG BACT determinations in Table D-2 are expressed

[14] 1,310 MWs represents the Most Severe New York Control Area Operating Capability Loss (a.k.a. largest single contingency). See NYISO January 24, 2019 presentation entitled "Operating Reserve Background". https://www.nyiso.com/documents/20142/4615689/2*201242019*20MIWG*20Reserve*20Background.pdf/b9642377-556a-ce87-39f1-e2773a4d9d7e

predominantly in units of lb CO_2e per MW-hr on either a “gross” or “net” basis. Energy units megawatt-hour (MW-hr) or kilowatt-hour (kW-hr) are more meaningful than mass emission limits since they relate directly to the efficiency of the equipment, which enables comparison of energy efficiency between different projects. Mass emissions are specific to the fuel firing rate of a given project, the number of operating hours, and the carbon content of the fuel, but do not incorporate project efficiency.

The GHG BACT emission rate must take into account both performance margin and degradation, as follows:

- performance margin accounts for the possibility that the equipment as constructed and installed may not fully achieve the optimal vendor specified design performance; and
- degradation accounts for the normal wear and tear of the combustion turbine over its useful life and particularly between maintenance overhauls.

The proposed performance margin and degradation factors for the Project are as follows:

- a performance design margin of 5.0% (reflected in GE performance guarantee); and
- an equipment degradation margin of 1.5%.

The adjustment factors have a compounding affect, so the overall margin and degradation applied from new and clean condition is 6.575% [1.05 × 1.015 = 1.06575].

In addition, proposing an H-class CTG provides the highest efficiency of any available comparably sized CTG. The Project will also be designed to maximize generation efficiency by minimizing sources of internal power consumption. Certain equipment, such as the SCR and oxidation catalysts, do result in pressure drop (and reduced power output). However, the SCR and oxidation catalysts are included to minimize emissions of criteria pollutants which have ambient air quality standards. Within the competing design and operational requirements, the Project will be designed to maximize net generation to the grid.

The lowest GHG BACT emission limit in Table D-2 is 1,151 lb CO_{2e}/MW-hr (gross) for gas firing and 1,551 lb CO_{2e}/MW-hr (gross) for ULSD firing for the West Medway Generating project in Massachusetts. This project is based on GE LMS-100 turbines, each rated at approximately 100 MW. The only H-Class simple cycle CTG in Table D-2 is the NRG Canal 3 GE HA.02 project with limits of 1,178 lb CO_{2e}/MW-hr (gross) for gas firing and 1,673 lb CO_{2e}/MW- hr (gross) for ULSD firing. The Puente Power permit for a GE 7HA.01 lists a CO_2 limit of 120 pounds per million Btu of gas fired; this project has since been cancelled.

A review of emission limits in SIPs did not identify any GHG emission limits for combustion turbines that are more stringent than limits achieved in practice by recently permitted and operated simple cycle CTGs subject to BACT requirements.

Step 5: Selection of BACT

Each of the three technically feasible options in Step 3 can be used in tandem and, therefore, the top-level of control would be the application of all three technologies. However, CCS is eliminated as a BACT option due to its economic, energy and environmental impacts as demonstrated in the following discussion. Astoria is proposing to implement the remaining two control technologies for GHG emission reduction, high-efficiency generating technology and low-carbon fuels. The Project will utilize an H-class CTG that provides the highest efficiency of any available comparably sized CTG. Based upon the Project design, and adding a performance plus degradation margin of 6.575% for the life of the Project, the CTG will meet a heat rate of 9,544 Btu (HHV)/kW-hr (gross) at full-load ISO conditions for natural gas firing, and 9,850 Btu (HHV)/kW-hr (gross) at full-load ISO conditions for ULSD firing. This is equivalent to GHG BACT emission rates of 1,119 lb CO_{2e}/MW-hr (gross) at full-load ISO conditions for natural gas firing and 1,608 lb CO_{2e}/MW-hr (gross) at full-load ISO conditions for ULSD firing. The gas-fired GHG BACT rate for the Project matches the lowest limit in Table D-2. For ULSD firing, the proposed GHG BACT emission rate is below all other oil-fired limits except for the West Medway Generating project. The proposed limit is also below the recently permitted GE 7HA.02 peaker for the NRG Canal 3 project.

The oil-fired GHG BACT for the GE LMS-100 units at West Medway is approximately 4% lower than the Project limit on ULSD. However, there are other disadvantages of an LMS-100 project to be considered as well. The LMS-100 is not a very space-efficient machine and four GE LMS-100 units (400 MW), including a collector bus switchyard, would occupy more than 10 acres (space that is not available at the Facility). The single 7HA.03 (no switchyard needed) only occupies about 6 acres. The LMS-100 also requires additional silencing to produce comparable noise levels and needs water injection for NO_X control while firing both natural gas and ULSD. All these factors make the H-class simple cycle unit a better selection for the Project.

CCS Economics Impacts

The capital expenditure required to capture CO_2 from the exhaust and compress it to the pressure required for transport and sequestration is prohibitive. The Report of the *Interagency Task Force on Carbon Capture and Storage* (ITF, 2010)[15] indicates that it costs approximately $105 per ton of CO_2 captured to install and operate a post-combustion system on a new installation to capture and compress CO_2 for transport and sequestration. This cost estimate is for a combined cycle CTG project with exhaust temperatures below 200°F whereas the Project's simple cycle CTG will have exhaust temperatures above 800°F and would require additional cost for either a heat exchanger to lower the exhaust temperature or a large injection of ambient air to lower the exhaust temperature within the operating range of the CO_2 capture system. Potential CO_2 emissions from the CTG are 706,810 tpy based on the operating scenario described in Section 2.6. Assuming an 80% capture efficiency results in an estimated annual cost of about $60,000,000 per year; which is clearly cost prohibitive.

If the Project were to use the northern Michigan sequestration site at some point in the future should it become operable, captured CO_2 would have to be transported by pipeline. Pipelines are the most common method for transporting large quantities of CO_2 over long distances. There are approximately 3,600 miles of existing pipeline located in the United States, but none of these pipelines currently goes from Queens towards northern Michigan. As such, a CO_2 transportation pipeline would need to be constructed from the Project location to the northern Michigan location. The cost for permitting and constructing this pressurized pipeline would be economically prohibitive and impractical. National Energy Technology Laboratory report on *Carbon Dioxide Transport and Storage Costs* (2017)[11] estimates the cost to construct a CO_2 pipeline is approximately $1 million dollars per mile. Therefore, the costs for a pipeline to Michigan would be more than $700 million dollars, which would more than double the cost of the Project.

There is limited cost data for the construction of standalone sequestration facilities, but a 2008 report from the USEPA entitled *Geologic CO_2 Sequestration Technology and Cost Analysis*[12] listed the cost of the sequestration facility for the proposed FutureGen project at $1.5 billion dollars for a 50-million-ton sequestration facility. The FutureGen project was initiated in 2010 but was cancelled in 2015 due to schedule overruns with injection well permitting that extended the project beyond the available dates for funding under the American Recovery and Reinvestment Act.

[15] https://www.energy.gov/fe/services/advisory-committees/interagency-task-force-carbon-capture-and-storage.

CCS Energy Impacts

CCS systems impose a very large parasitic load, which would reduce the overall efficiency of the Project. The *Interagency Task Force on Carbon Capture and Storage* (ITF, 2010)[10] estimates that the overall generating efficiency would be reduced by as much as a third. This would reduce the overall output of the plant by more than 100 MW. This reduction in efficiency would yield a cost to generate that would make it uneconomical to operate in the competitive NYISO market.

CCS Environmental Impacts

The reduction in overall plant output would not result in a ton per year reduction in any other pollutants that are subject to BACT. As a result, the emissions of every non-GHG BACT subject pollutant would increase by 50% on a lb/MWh basis. This increase in criteria pollutant emissions is clearly counterproductive for LAER and BACT for criteria pollutants.

In summary, CCS is not commercially available for the Project. Further, at the current state of development of CCS technology, the costs for CCS would be more than double the cost of the Project, making it economically infeasible. Therefore, CCS was eliminated as a BACT option for the Project.

4.2.4 Summary of Proposed Steady-state BACT Emission Limits for the CTG

Table 4-1 summarizes the proposed BACT emission limits and associated control technology for the proposed CTG.

Table 4-1 Proposed PSD BACT Emission Limits for the Combustion Turbine

Pollutant	Fuel	Emission Rate (lb/MMBtu)	Emission Rate (lb/hr)	Control Technology
$PM/PM_{10}/PM_{2.5}$	Natural Gas, ≥75% Load	0.0082	23.2	Good combustion controls and low sulfur fuels
	Natural Gas, <75% Load	0.0097	19.2	
	ULSD, ≥75% Load	0.025	71.1	
	ULSD, <75% Load	0.032	68.7	
GHG	Natural Gas	1,119 lb/MW-hr	n/a	High efficiency generation and low emitting fuels
	ULSD	1,608 lb/MW-hr	n/a	

4.3 Emergency Generator BACT

4.3.1 Fuel

4.3.1.1 Step 1: Identification of Control Technology Options

The raw material for the emergency generator engine is the fuel. It is critical for the emergency generator engine to have its own stand-alone fuel source in the event that the emergency includes disruption of fuel from an outside source, such as natural gas. The primary purpose of the emergency generator will be to shut the plant down safely in the event of an electric power outage. Generator engines are available that can fire natural gas or diesel; to incorporate a stand-alone fuel source, the available fuel options are LNG and ULSD.

4.3.1.2 Step 2: Identification of Technically Infeasible Control Technology Options

Use of interruptible natural gas is not feasible for an emergency engine that must be able to operate during an emergency. LNG storage was eliminated as technically infeasible per the Fuels BACT analysis for the CTG.

4.3.1.3 Step 3: Ranking of Technically Feasible Control Technology Options

The sole stand-alone fuel source available for the emergency generator engine is ULSD.

4.3.1.4 Step 4: Evaluation of Most Effective Controls

6 NYCRR Subpart 225-1 regulates sulfur content of fossil fuels. Distillate oil fuel sulfur is limited to 0.0015% by weight (equivalent to 15 ppmw).

4.3.1.5 Step 5: Select BACT

The emergency generator engine will be fired with ULSD having a sulfur content no greater than 0.0015% by weight (15 ppmw).

4.3.2 PM/PM_{10}/$PM_{2.5}$

4.3.2.1 Step 1: Identification of Control Technology Options

Process Modifications

Low-PM engine design is the only known process modification that can be made to reduce PM/PM_{10}/$PM_{2.5}$ emissions from a diesel engine.

Add-on Controls

A diesel particulate matter filter ("DPF") is a technically feasible option to control PM/PM_{10}/$PM_{2.5}$ emissions from an emergency generator.

4.3.2.2 Step 2: Identification of Technically Infeasible Control Technology Options

Low-PM engine design and a DPF are both technically feasible, although application of a DPF is unusual for an emergency generator diesel engine. Engines that meet the final Tier 4 standards under 40 CFR 1039.101(b), Table 1 are equipped with a DPF.

4.3.2.3 Step 3: Ranking of Technically Feasible Control Technology Options

Low-PM engine design and a DPF are both technically feasible and the top level of control.

4.3.2.4 Step 4: Evaluation of Most Effective Controls

Stationary internal combustion engines are subject to 40 CFR Part 60, Subpart IIII and 40 CFR 63, Subpart ZZZZ. A review of emission limits in SIPs did not identify any PM emission limits for new emergency engines that are more stringent than the limits provided in 40 CFR 89.

A review of recent PM emission limits for emergency generator diesel engines installed as part of a major source simple cycle generating project, as summarized in Table D-4 in Appendix D, show that most of these engines were required to meet the applicable emission limitations for non-road engines under 40 CFR Part 89 as required by 40 CFR 60, Subpart IIII. One emergency engine for the Puente Power project in California is permitted to meet the final Tier 4 PM limit of 0.02 grams per horsepower-hour ("g/hp-hr").

4.3.2.5 Step 5: Selection of BACT

The top level of control would be the installation of a Tier 4 certified engine with a DPF. The Project's emergency generator will be equipped with DPF and will comply with the Tier 4 PM limit which is 0.03 g/kWm-hr. Compliance with this emission limit is based on the applicable 40 CFR 1039 or 40 CFR 60 Subpart IIII emission test cycle as demonstrated by manufacturer's certification.

The proposed controls represent BACT and is the most stringent level of control demonstrated in practice.

4.3.3 GHGs

GHG BACT discussion for the CTG describes the difficulties in controlling GHG emissions from combustion sources. The emergency generator engine is an insignificant source of GHG emissions at 204 tpy. There are no technically feasible means of reducing GHG emissions from the emergency generator engine other than restricting operating hours. The emergency generator engine will operate no more than 500 hrs/yr for all operations. This restriction will limit annual GHG emissions to 204 tpy, which is consistent with the limits for other emergency generator engines listed in Table D-3 in Appendix D.

4.4 Emergency Fire Pump BACT

4.4.1 Fuel

4.4.1.1 Step 1: Identification of Control Technology Options

The raw material for the emergency fire pump engines is the fuel. It is critical for the emergency fire pump engines to have their own stand-alone fuel source in the event that the emergency includes disruption of fuel from an outside source, such as natural gas. The purpose of the emergency fire pump is to provide firefighting capability during a fire onsite. Fire pump engines are available that can fire natural gas or diesel; to incorporate a stand-alone fuel source, the available fuel options are LNG and ULSD.

It is important to note here as well that redundant fire pumps will be provided for the Project to ensure 100% backup on each of the fire protection systems. On each of the foam and deluge systems, one fire pump will be driven by an electric motor and the other will be driven by a diesel engine. Each pump will be capable of delivering total system requirements at design pressure and flow rate with any one pump out of service. Therefore, the diesel fire pump engine is essentially a backup unit that would typically be used in a fire fighting emergency if there is also a simultaneous loss of electric power.

4.4.1.2 Step 2: Identification of Technically Infeasible Control Technology Options

Use of interruptible natural gas is not feasible for an emergency fire pump engine that must be able to operate during an emergency. LNG storage was eliminated as technically infeasible at the Facility per the Fuels BACT analysis for the CTG.

4.4.1.3 Step 3: Ranking of Technically Feasible Control Technology Options

The sole stand-alone fuel source available for the emergency diesel fire pump is ULSD.

4.4.1.4 Step 4: Evaluation of Most Effective Controls

6 NYCRR Subpart 225-1 regulates sulfur content of fossil fuels. Distillate oil fuel sulfur is limited to 0.0015% by weight (15 ppmw).

4.4.1.5 Step 5: Selection of BACT

The emergency diesel fire pump engine shall be fired with ULSD having a sulfur content no greater than 0.0015% by weight (15 ppmw).

4.4.2 PM/PM_{10}/$PM_{2.5}$

4.4.2.1 Step 1: Identification of Control Technology Options

Process Modifications

Low-PM engine design is the only known process modification that can be made to reduce PM emissions from a diesel engine. Low-emission engine design for a 117 kWm bhp emergency diesel fire pump engine is a Tier 3 engine rated at 0.3 g/kWm. Low-emission engine design for a 177 kWm bhp emergency diesel fire pump engine is a Tier 3 engine rated at 0.2 g/kWm.

Add-on Controls

DPF is a technically feasible option to control PM emissions from diesel engines.

4.4.2.2 Step 2: Identification of Technically Infeasible Control Technology Options

Low-PM engine design and DPF are both technically feasible, although application of a DPF is unusual for emergency diesel fire pump engines.

4.4.2.3 Step 3: Ranking of Technically Feasible Control Technology Options

An active DPF can achieve up to 85% particulate removal (CARB Level 3), so it is more effective than the Tier 3 engine design, which is based on low-emission engine design.

4.4.2.4 Step 4: Evaluation of Most Effective Controls

Stationary internal combustion engines are subject to 40 CFR Part 60, Subpart IIII and 40 CFR 63, Subpart ZZZZ. These regulations require a new emergency fire pump engine to meet the applicable emission standards under NSPS Subpart IIII, Table 4. The applicable PM limits under NSPS Subpart IIII, Table 4 are equal to Tier 3 limits in 40 CFR 89. A review of emission limits in SIPs did not identify any PM emission limits for new emergency fire pump engines that are more stringent than the limits provided in NSPS Subpart IIII, Table 4.

A review of recent PM emission limits for emergency fire pump diesel engines installed as part of major source simple cycle generating projects, as summarized in Table D-5 in Appendix D show that these engines were required to meet the applicable emission limitations for non-road engines under 40 CFR 60, Subpart IIII. No limits were found that required installation of add-on pollution controls for emergency fire pump diesel engines.

4.4.2.5 Step 5: Selection of BACT

The top level of control would be the installation of both a low-PM engine with DPF. However, DPF was eliminated due to economic impacts as described below. The next level of control was determined to be compliance with the applicable limits under 40 CFR Part 60, Subpart IIII and firing of ULSD that meets the requirements of 40 CFR 80, Subpart I.

The applicable limit for a 117 kWm new emergency fire pump engine is NSPS Subpart IIII, Table 4, which is 0.30 g/kWm-hr for PM, PM_{10} and $PM_{2.5}$.

The applicable limit for a 177 kWm new emergency fire pump engine is NSPS Subpart IIII, Table 4, which is 0.20 g/kWm-hr for PM, PM_{10}, and $PM_{2.5}$.

Economic Impacts

Since a DPF is technically feasible, an economic analysis of the cost effectiveness for emission control was conducted. This economic analysis is presented in Appendix D. This analysis indicates that the cost effectiveness of an active DPF is in the range of $520,000-650,000 per ton of $PM/PM_{10}/PM_{2.5}$ reduced. This cost is excessive, even if the emergency diesel fire pump engines were to run the maximum allowable amount of 500 hrs/yr (unlikely).

There are no collateral energy or environmental issues with a fire pump engine that would indicate selection of a DPF is BACT, given the unfavorable economics.

The proposed controls represent the top level of control that have been demonstrated to be achievable in practice.

4.4.3 GHGs

The GHG BACT discussion for the CTG describes the difficulties in controlling GHG emissions from combustion sources. The emergency fire pump engines are insignificant sources of GHG emissions at a combined 121 tpy. There are no technically feasible means of reducing GHG emissions from the emergency fire pump engine other than restricting operating hours. The emergency fire pump engine will operate no more than 100 hrs/yr for readiness testing purposes in accordance with NSPS Subpart IIII and will operate no more than 500 hrs/yr in total. These restrictions will limit annual GHG emissions to a combined 121 tpy, which is consistent with the limits for other emergency fire pump engines listed in Table D-4 in Appendix D.

4.4.4 Ancillary Source BACT Summary

Table 4-3 summarizes the proposed PSD BACT emission limits and associated control technology for the Project's ancillary emission sources.

Table 4-3: Proposed BACT Limits for the Ancillary Sources

Pollutant	Emergency Generator	Emergency Fire Pump #1	Emergency Fire Pump #2
$PM/PM_{10}/PM_{2.5}$	0.03 g/kWm-hr[1]	0.3 g/kWm-hr[1]	0.2 g/kWm-hr[1]
GHGs	204 tpy	48 tpy	73 tpy

(1) Proposed emission limits in accordance with applicable 40 CFR 1039 or 40 CFR 60 Subpart IIII emission test cycle as demonstrated by manufacturer's certification.

4.5 Fugitive GHG Emission Sources

The Project will include natural gas handling systems and circuit breakers that contain SF_6. Fugitive losses of natural gas and SF_6 will contribute to GHG emissions from the Project. SF_6 circuit breakers are required for high voltage transmission systems. The Project will connect with the Con Ed regional transmission system operating at 138 kilovolts ("kV") and, therefore, will require 138-kV circuit breakers. The highest voltage SF_6- free circuit breaker commercially available operates at 72.5-kV, well below the voltage requirement for the Project.

The other sources of fugitive emissions from the Project are connections in the natural gas handling system including connectors, flanges, regulators, valves, and meters. The only means of controlling these emissions would be to eliminate component leaks. However, there are no known leak-free connectors, flanges, regulators, valves, or meters commercially available to control these fugitive emissions. Prior to operation, Astoria will develop a written plan for minimizing leaks from these components, which shall include, at a minimum, daily auditory/visual/olfactory inspections of the natural gas piping components supplying natural gas to the combustion turbine. Estimated fugitive GHG emissions are 2,708 tpy (see Appendix C).

In order to minimize fugitive GHG emissions, the Project will implement current BACT operating standards for these emission sources, including the following:

- Implement an auditory/visual/olfactory leak detection program for the natural gas piping components.
- Equip each SF_6 containing circuit breaker with a low-pressure alarm and low pressure lockout. SF_6 emissions from each circuit breaker will be calculated annually (calendar year) in accordance with the mass balance approach in Equation DD-1 of 40 CFR 98, Subpart DD. The maximum annual leakage rate for SF_6 will not exceed 0.5% of the total SF_6 storage capacity of the plant's circuit breakers.
- Maintain records of all measurements and reports related to the fugitive emission sources, including those related to maintenance and compliance monitoring.

5.0 Air Quality Impact Assessment

Dispersion modeling was conducted for the Project sources in accordance with NYSDEC's DAR-10 (Draft, 2020) and the USEPA *Guideline on Air Quality Models* ("GAQM", which is contained in 40 CFR Part 51, Appendix W) (USEPA 2017) to demonstrate modeled compliance with the NAAQS and PSD increments. Modeling of the Project emissions has also been conducted for air toxic compounds in accordance with NYSDEC's DAR-1 (2016a) for evaluating air toxic compounds relative to the Short-term and Annual Guideline Concentrations ("SGCs" and "AGCs", respectively).

The dispersion modeling addressed the following combustion sources associated with the Project:

- One approximately 440 MWe simple cycle CTG with dual-fuel firing capability (natural gas and ULSD);
- One 500 kWe ULSD-fired emergency generator;
- Two ULSD-fired emergency fire system pumps; 117 and 177 kWm, respectively; and
- One existing P&W Twin Pac (consisting of two individual turbines) to be used for black-start capability.

The dispersion modeling analysis followed the methodology outlined in the modeling protocol submitted to NYSDEC and also addresses NYSDEC's review comments on the protocol (see March 10, 2020 email from Thomas John/NYSDEC provided in Appendix E). The dispersion modeling file archive containing all model input and output files is provided on the CD in Appendix E.

As documented in the subsections below, the modeling analyses demonstrate that the air quality impacts associated with the Project are below the Class I and Class II SILs thus demonstrating compliance with the NAAQS and PSD increments. In addition, the Project modeled concentrations for air toxic compounds are below all SGCs/AGCs.

5.1 Overview of Methodology

Dispersion modeling was conducted for all Project emission sources of NO_X, CO, SO_2, PM_{10} and $PM_{2.5}$ to evaluate compliance with the NAAQS and PSD increments (see Table 3-1 and 3-2, respectively).

Dispersion modeling was initially conducted for the new CTG to determine the maximum impact operating scenario over the range of operating loads, ambient temperatures, steady-state operations, and start-up/shut-down operations for modeling with the emergency generator, and emergency fire-system pumps. Then the worst-case emission scenarios for the CTG were modeled with the ancillary sources to perform modeling of the Project emissions alone to determine if the modeled impacts are above their respective SILs (see Table 3-3).

The use of the SILs is applicable for this Project for all pollutants and averaging periods because the difference between the NAAQS and the representative ambient background is greater than the SILs. This is discussed in more detail in Section 5.10. For Project modeled concentrations less than the SILs, no further modeling is required to demonstrate compliance with the NAAQS. For Project modeled impacts greater than the SILs, cumulative modeling is required to demonstrate that the Project, existing facility sources, and off-site background sources show compliance with the NAAQS (including ambient background component) and PSD increments, as necessary.

As detailed further in Section 5.12.2, the modeling indicates that the Project modeled impacts are less than the SILs for all pollutants and therefore no further modeling (i.e., a cumulative analysis) was required for the Project to demonstrate compliance with the NAAQS and PSD increments.

5.2 Project Sources

The modeling for the Project was conducted utilizing the maximum impact operating conditions for the CTG to estimate the highest impact for each averaging period. Specifically, all potential steady-state operating cases covering the various loads, ambient temperatures, and fuel options were modeled to identify the maximum impact case for steady-state CTG operations for each pollutant and averaging period. CTG maximum impacts scenarios were modeled with the emergency generator, and emergency fire system pumps to conduct the SIL modeling analysis.

The emergency generator and fire system pumps will be operated no more than 1 hour per week for maintenance and no more than 500 hours per year in total (maintenance and emergency operation). Therefore, the modeled emission rates for the emergency generator and fire system pumps were normalized based on the 500 hours per year for annual modeling and 1 hour of operation in the modeled averaging period for short-term modeling.

Note, as intermittent sources, the emergency generator, fire system pumps and P&W combustion turbines were not included in the 1-hour NO_2 and SO_2 modeling as discussed further below.

The potential emissions for the Project sources are summarized in Table 2-3.

5.2.1 Simple Cycle Combustion Turbine

5.2.1.1 Steady-state Operation

The short-term emission rates and stack exhaust parameters for the proposed simple cycle CTG are provided in Table 5-1 (gas) and Table 5-2 (ULSD). Data are provided over a range of operating loads and ambient temperature operating conditions as summarized below:

- operating loads: base (100%) with and without evaporation cooling, mid loads (75% and 50%), and minimum loads (30-40%); and
- ambient temperatures: 100°F (high), 59°F (ISO), 54.6°F (annual average) and -5°F (low).

The CTG annual emission modeling parameters are provided in Table 5-3. Table 5-3 lists the various CTG operating cases that make up the annual composite emissions scenario. The CTG was represented as four separate co-located stacks in the model corresponding to the four modes of operation to simulate the annual emissions case.

5.2.1.2 Start-up/Shutdown (SU/SD) Operation

The turbine manufacturer's information indicates that the CTG unit will be able to achieve compliance with steady-state emission limits within a maximum of 30 minutes of initiating fuel combustion in the CTG. To be conservative in the modeling, SU duration was assumed to be 20 minutes from initiating fuel firing in the CTG until steady-state emission limits are achieved. To represent this in the SIL modeling, a representative profile of emissions was used that accounts for either a SU or SD event with the balance of the hour represented by steady-state operations. This was simulated in the modeling using two stacks; one stack representing the worst-case of either a SU or SD and the other stack for steady-state operations representing the balance of the hour that the CTG is not operating in SU or SD mode. Table 5-4 presents emissions and stack parameters for SU and SD. Therefore, SU emissions and stack parameters for ULSD were used for the stack representing SU/SD operations. The emissions for the steady-state operations stack were scaled based on the portion of the hour that the CTG is operating under steady-state conditions (i.e., 40 minutes).

This hourly emissions scenario was also used to model the other short-term averaging periods (≤ 24-hours). This is extremely conservative since it inherently assumes the worst-case start-up on ULSD coupled with the worst steady-state case occurring every hour in the modeling.

5.2.2 Ancillary Sources

Table 5-5 provides stack parameters and emission rates for the emergency generator, two emergency fire-system pumps and P&W Twin Pac turbines that will be used for black-start. The emergency generator and fire system pump engine stacks will be equipped with dedicated stacks (all vertical discharge with no fixed rain caps; flapper cover may be used but will not restrict vertical discharge of the exhaust).

The emergency generator and fire system pumps will be operated no more than one (1) hour/week for maintenance and up to 500 hours/year annually for maintenance and emergency use. As noted, an existing P&W Twin Pac (two turbines) will remain operational to maintain black-start capability. Operation of the P&W Twin Pac turbines will be limited to a maximum of 12 hours/year. The P&W Twin Pac will be fueled with natural gas with and ULSK.

The modeled short-term (≤ 24 hours) emissions for the emergency generator, fire system pump engines and P&W Twin Pac turbines were normalized to one (1) hour for short-term modeling and the modeled annual emission rates were normalized based on the 500 hours/year and 12 hours/year, respectively. Note, as intermittent sources, the emergency generator, fire system pump and P&W Twin Pac turbines were not included in the 1-hour NO_2 and SO_2 modeling in accordance with NYSDEC policy for intermittent sources.

5.3 Model Selection

The suitability of an air quality dispersion model for each application is dependent upon several factors. The following selection criteria were evaluated:

- stack height relative to nearby structures;
- dispersion environment;
- local terrain; and
- representative meteorological data.

The USEPA's Guideline prescribes a set of approved models for regulatory applications for a wide range of source types and dispersion environments. Based on a review of the factors discussed below, the latest version of AERMOD (Version 19191) was used to assess air quality impacts for the Project.

Table 5-1 Simple Cycle CTG Steady-state Operation Stack Parameters and Emission Rates – Natural Gas (250-ft Stack)

Operating Case	Load(1)	Evaporative Cooling Status	Ambient Temp. (°F)	Relative Humidity (%)	Stack Temp. (°K)	Exhaust Velocity (m/sec)	Stack Diam. (m)	Hourly Emissions [grams per second ("g/s")]			
								CO	NO_X	PM_{10}/ $PM_{2.5}$	SO_2
CASE 7	Base WC	Evap turn On	100	40	722.1	45.1	8.7	3.916	4.596	3.188	0.701
CASE 8	Base	Evap turn On	100	40	722.1	43.4	8.7	3.639	4.271	3.137	0.652
CASE 9	Base	Evap Off	100	40	722.1	41.1	8.7	3.361	3.945	3.125	0.602
CASE 10	75%	Evap Off	100	40	722.1	32.7	8.7	2.621	3.077	2.230	0.469
CASE 11	50%	Evap Off	100	40	722.1	27.0	8.7	2.001	2.348	2.092	0.358
CASE 12	MECL(40%)	Evap Off	100	40	722.1	24.6	8.7	1.745	2.048	2.041	0.312
CASE 25	Base	Evap turn On	59	60	722.1	43.6	8.7	3.860	4.530	3.049	0.691
CASE 26	Base	Evap Off	59	60	722.1	43.2	8.7	3.789	4.448	3.037	0.678
CASE 27	75%	Evap Off	59	60	722.1	33.8	8.7	2.922	3.429	2.230	0.523
CASE 28	50%	Evap Off	59	60	722.1	27.7	8.7	2.214	2.599	2.104	0.396
CASE 29	MECL(30%)	Evap Off	59	60	722.1	22.6	8.7	1.631	1.914	2.003	0.292
CASE 30	Base	Evap Off	54.6	55	722.1	43.3	8.7	3.829	4.494	3.037	0.685
CASE 31	75%	Evap Off	54.6	55	722.1	33.8	8.7	2.949	3.462	2.230	0.528
CASE 32	50%	Evap Off	54.6	55	722.1	27.8	8.7	2.232	2.620	2.104	0.400
CASE 33	MECL(30%)	Evap Off	54.6	55	722.1	22.6	8.7	1.642	1.928	2.003	0.294
CASE 42	Base	Evap Off	-5	56	722.1	41.1	8.7	3.882	4.557	2.822	0.695
CASE 43	75%	Evap Off	-5	56	722.1	32.7	8.7	3.018	3.542	2.205	0.540
CASE 44	50%	Evap Off	-5	56	722.1	27.0	8.7	2.299	2.699	2.079	0.412
CASE 45	MECL(39.4%)	Evap Off	-5	56	722.1	24.5	8.7	1.985	2.330	2.029	0.355

(1) WC = Wet Compression
MECL = Minimum Emissions Compliant Load

Table 5-2 Simple Cycle CTG Steady-state Operation Stack Parameters and Emission Rates – ULSD (250-ft Stack)

Operating Case	Load(1)	Evaporative Cooling Status	Ambient Temp. (°F)	Relative Humidity (%)	Stack Temp. (°K)	Exhaust Velocity (m/sec)	Stack Diam. (m)	Hourly Emissions (g/s)			
								CO	NO_X	PM_{10}/ $PM_{2.5}$	SO_2
CASE 52	Base WC	Evap turn On	100	40	722.1	42.9	8.7	5.855	9.621	8.958	0.760
CASE 53	Base	Evap turn On	100	40	722.1	41.4	8.7	5.521	9.072	8.921	0.717
CASE 54	Base	Evap Off	100	40	722.1	39.5	8.7	5.133	8.435	8.895	0.666
CASE 55	75%	Evap Off	100	40	722.1	31.7	8.7	4.011	6.591	8.442	0.521
CASE 56	MECL(50%)	Evap Off	100	40	722.1	28.2	8.7	3.153	5.181	8.618	0.409
CASE 67	Base	Evap turn On	59	60	722.1	41.9	8.7	5.900	9.695	8.908	0.766
CASE 68	Base	Evap Off	59	60	722.1	41.5	8.7	5.821	9.565	8.895	0.756
CASE 69	75%	Evap Off	59	60	722.1	33.4	8.7	4.522	7.431	8.555	0.587
CASE 70	MECL(50%)	Evap Off	59	60	722.1	29.3	8.7	3.525	5.792	8.656	0.458
CASE 71	Base	Evap Off	54.6	55	722.1	41.7	8.7	5.889	9.677	8.895	0.765
CASE 72	75%	Evap Off	54.6	55	722.1	33.5	8.7	4.575	7.518	8.580	0.594
CASE 73	MECL(50%)	Evap Off	54.6	60	722.1	29.4	8.7	3.566	5.860	8.656	0.463
CASE 80	Base	Evap Off	-5	56	722.1	39.9	8.7	5.951	9.779	8.807	0.773
CASE 81	75%	Evap Off	-5	56	722.1	33.3	8.7	4.723	7.762	8.643	0.613
CASE 82	MECL(63%)	Evap Off	-5	56	722.1	31.1	8.7	4.220	6.934	8.618	0.548

(1) WC = Wet Compression
MECL = Minimum Emissions Compliant Load

Table 5-3 Simple Cycle CTG Annual Emissions

Operating Case	Fuel	Load	Evap	Ambient Temp. (°F)	Annual Operating Hours	Stack Height (m)	Stack Temp. (°K)	Stack Velocity (m/sec)	Stack Diam. (m)	Annual Emissions (g/s)(4)		
										NO_X	PM_{10} / $PM_{2.5}$	SO_2
Case 25/ Steady-state(1)	Nat. Gas	Base	Evap On	59	1900	76.2	722.1	43.6	8.69	9.97E-01	6.91E-01	1.52E-01
SU/SD(2)	Nat. Gas	SU/SD	-	-	180	76.2	716.9	20.0	8.69	6.54E-01	4.06E-02	8.28E-03
Case 80/ Steady-state(3)	ULSD	Base	Evap Off	-5	720	76.2	722.1	39.9	8.69	8.04E-01	7.36E-01	6.35E-02
SU/SD(2)	ULSD	SU/SD	-	-	65	76.2	716.3	18.2	8.69	3.24E-01	4.11E-02	3.37E-03

(1) Representative annual steady-state operating case for natural gas.
(2) Emissions represent the total annual emissions for SU and SD. Stack parameters are the worst-case parameters between SU and SD.
(3) Representative annual steady-state operating case for ULSD.
(4) The sum of the g/sec emissions for all operating cases is equivalent to tpy values in Table 2-1.

Table 5-4 Simple Cycle CTG SU/SD Operation Stack Parameters and Emission Rates

Operating Case	Fuel	Stack Temp. (°K)	Stack Velocity (m/s)	Stack Diam. (m)	Hourly Emissions (g/s)(1)			
					NO_X	$PM_{10}/PM_{2.5}$	CO	SO_2
SU	Nat. Gas	715.3	18.9	8.53	24.57	1.18	17.64	0.29
SD	Nat. Gas	719.1	22.8	8.53	7.25	0.79	12.60	0.11
SU	ULSD	716.3	18.2	8.53	28.98	3.15	54.18	0.33
SD	ULSD	722.0	24.8	8.53	14.74	2.39	27.85	0.13

(1) Based on estimated lb/event SU/SD emissions in Appendix C. Stack parameters based on worst-case load for each fuel configuration.

Table 5-5 Stack Parameters and Emission Rates for the Ancillary Equipment

Source	Stack Height (m)	Stack Temp. (°K)	Stack Velocity (m/sec)	Stack Diam. (m)	Short-Term Emissions (g/sec)								Annual Emissions (g/sec)			
					CO 1-Hr	CO 8-Hr	NO_x 1-Hr	$PM_{2.5}$ 24-Hr	PM_{10} 24-Hr	SO_2 1-Hr	SO_2 3-Hr	SO_2 24-Hr	NO_x	PM_{10}	$PM_{2.5}$	SO_2
P&W Twin Pac (per turbine)(1)	11.58	627.0	17.4	3.97	1.24E+01	1.55E+00	-	4.69E-02	4.69E-02	-	3.64E-02	4.55E-03	4.30E-02	1.54E-03	1.54E-03	1.50E-04
Emergency Generator(2)	3.96	692.5	35.9	0.200	5.39E-01	6.74E-02	-	1.93E-04	1.93E-04	-	3.31E-04	4.14E-05	5.89E-03	2.64E-04	2.64E-04	5.67E-05
117 kWm Fire System Pump(2)	5.18	704.8	43.3	0.102	1.63E-01	2.03E-02	-	4.06E-04	4.06E-04	-	7.78E-05	9.73E-06	7.42E-03	5.57E-04	5.57E-04	1.33E-05
177 kWm Fire System Pump(2)	5.18	704.8	29.1	0.152	1.72E-01	2.15E-02	-	4.10E-04	4.10E-04	-	1.18E-04	1.48E-05	1.12E-02	5.61E-04	5.61E-04	2.02E-05

(1) Assumes 1 hr/day operation for short-term averaging periods (≤ 24 hrs) and 12 hrs/yr. Because these units are intermittent, modeling for 1-hour NO_2 and 1-hour SO_2 is not required.

(2) Assumes 1 hr/day operation for short-term averaging periods (≤ 24 hrs) and 500 hrs/yr. Because these units are intermittent, modeling for 1-hour NO_2 and 1-hour SO_2 is not required.

5.4 Good Engineering Practice Stack Height Analysis

USEPA and NYSDEC modeling guidelines require the evaluation of the potential for physical structures to affect the dispersion of emissions from stack emission points. The exhaust from stacks that are located within specified distances of buildings, and whose physical heights are below specified levels, may be subject to "aerodynamic building downwash" under certain meteorological conditions.

The analysis used to evaluate the potential for building downwash is referred to as a physical good engineering practice ("GEP") stack height analysis. Stacks with heights below physical GEP are considered to be subject to building downwash. In the absence of influencing structures, a "default" GEP stack height is credited up to 65 m (213 feet) per the *Guideline for Determination of Good Engineering Practice Stack Height* (USEPA 1985). Any portion of a stack above the maximum of the physical or default GEP height cannot be used in the dispersion modeling analysis for purposes of comparison to USEPA's ambient impact criteria.

A GEP stack height analysis was performed for all point/stack sources included in the modeling. Per the guidelines, the physical GEP height ("H_{GEP}") is determined from the dimensions of all buildings that are within the region of influence using the following equation:

$$H_{GEP} = H + 1.5L$$

where:

H = height of the structure within 5L of the stack which maximizes H_{GEP}, and

L = lesser dimension (height or projected width) of the structure.

For a squat structure (*i.e.,* height less than projected width), the formula reduces to:

$$H_{GEP} = 2.5H$$

Wind direction-specific building dimensions for input to AERMOD for all Project stacks were developed with the PRIME version of USEPA's Building Profile Input Program (BPIP-PRIME). BPIP-PRIME input and output files are provided with the modeling archive submitted to NYSDEC with this application. Figure 5-1 shows the location of the Project stacks, buildings, structures and their heights used in the GEP analysis. A summary of the GEP stack height analysis for the Project sources is presented in Table 5-6.

Table 5-6 Summary of GEP Analysis

Emission Source	Stack Height (m)	Controlling Buildings / Structures	Building Height (m)	Projected Width (m)	GEP Formula Height (m)
Combustion Turbine Generator	76.2	Poletti Power Structure	30.48	30.74	74.22(1)
P&W Twin Pac - Stack 1	11.58	CTG Inlet Filter	28.81	20.0	59.59(2)
P&W Twin Pac – Stack 2	11.58	CTG Inlet Filter	28.81	20.00	59.59(2)
Emergency Generator	3.96	Poletti Power Structure	30.48	35.42	74.22(1)
Fire System Pump (117 kWm)	5.18	ULSD Tanks	14.94	23.94	35.37(1)
Fire System Pump (177 kWm)	5.18	ULSD Tanks	14.94	23.94	35.37(1)

(1) Adjusted for a stack-building elevation difference of 1.98 m.

(2) Adjusted for a stack-building elevation difference of -0.76 m.

5.5 Dispersion Environment

The application of the AERMOD requires characterization of the local (within 3 km) dispersion environment as either urban or rural, based on a USEPA-recommended procedure that characterizes an area by prevalent land use. This land use approach classifies an area according to 12 land use types. In this scheme, areas of industrial, commercial, and compact residential land use are designated urban. According to USEPA modeling guidelines, if more than 50% of an area within a 3-km radius of the project site is classified as rural, then a rural model application is required. Conversely, if more than 50% of the area is urban, an urban dispersion adjustment can be used.

Visual inspection of the satellite image of the 3-km area surrounding the facility location (see Figure 5-2) shows the area is clearly urban. Therefore, the urban model option in AERMOD was used. Use of the urban option requires a population value that AERMOD uses to estimate the nighttime urban boundary layer height. The AERMOD Implementation Guide (USEPA 2018d) indicates that published census data corresponding to the Metropolitan Statistical Area ("MSA") for the modeled location may be used for this purpose. Because the extent of the New York MSA exceeds the proposed 20-km modeling domain, using the total population for the MSA for this modeling analysis may overstate the urban heat island effect incorporated into AERMOD. Therefore, the estimated total population within the 20-km modeling domain was used. Figure 5-3 shows the New York and New Jersey counties that fall within a 20-km radius of the Facility. The 2019 estimated population (US Census Bureau 2020) of the following counties was summed to determine a total population of 9,066,976 that were used for input to AERMOD:

- New York County, NY – 1,628,701
- Bronx County, NY – 1,432,132
- Kings County, NY – 2,582,830
- Queens County, NY – 2,278,906
- Hudson County, NJ – 676,061
- Bergen County, NJ – 468,346 (half the population will be used)

5.6 Meteorological Data

If at least one year of hourly on-site meteorological data is not available, the application of a refined dispersion model requires five years of hourly meteorological data most representative of the project site. This application utilized five years (2014-2018) of concurrent surface meteorological data from

LaGuardia Airport coupled with upper air data from Brookhaven, NY. The LaGuardia Airport is less than 2 miles from the Astoria Facility (see Figure 5-2). AERMOD-ready meteorological data were obtained from NYSDEC for use in this application, which were processed with USEPA's AERMET program (AERMOD meteorological data processor) using the "Adj_u*" option.

5.7 Receptor Grid and AERMAP Processing

5.7.1 Ground-Level Receptors

The USEPA GAQM and NYSDEC DAR-10 modeling guidelines require that the differences in terrain elevations between the stack top, plume centerline and model receptor locations be considered in the modeling analyses. A comprehensive Cartesian receptor grid extending to 20 km was developed for use in AERMOD to assess maximum ground-level pollutant concentrations.

The Cartesian receptor grid consisted of the following receptor spacing:

- 50-meter ("m") increments beyond the fence out to 1 km;
- 100-m increments beyond 1 km out to 2.5 km;
- 250-m increments beyond 2.5 km out to 5 km;
- 500-m increments beyond 5 km out to 10 km; and
- 1000-m increments beyond 10 km out to 20 km.

Additional receptors were placed every 25 m along the continuously fenced property boundary of the Facility. This receptor grid was sufficient to resolve all maximum modeled impacts associated with the Project as the maximum concentrations were modeled in areas of 50 m spacing.

Terrain elevations were developed from 1/3 arc second (~10-meter resolution) National Elevation Dataset ("NED") data acquired from United States Geological Survey ("USGS" (https://viewer.nationalmap.gov/basic/). Receptors and terrain elevations were processed with USEPA's AERMAP (version 18081). Figure 5-4 and Figure 5-5 show the near-field and far-field receptors, respectively.

5.7.2 Elevated/Flagpole Receptors

In addition to the ground-level receptors, elevated receptors in proximity to the Project were also assessed. The elevated receptors, simulated in the modeling using the flagpole receptor option, include rooftops, balconies, and similar areas with public access, but not at open windows or air intakes, in accord with USEPA policy. The modeling utilized the same flagpole receptors that were approved for the previous modeling assessment for the site (ARG 2010), supplemented with additional receptors to represent new buildings that have been constructed since 2010. Newly constructed buildings were found by comparing archived Google Earth™ satellite imagery prior to 2010 to the most recent imagery. The search radius included the immediate vicinity of the facility (about 4 km) with a focus on multi-story residential buildings and schools. The search resulted in three newly constructed buildings located to the northeast and west of the facility. While not included in the 2010 receptor set and not newly constructed, three additional residential buildings south of the facility were also selected as flagpole receptors because they are in close proximity (< 1 km) to the facility. The six additional receptors were assigned flagpole heights based on the same methodology as the previous 2010 analysis, which used elevations corresponding to the rooftop as well as half the building height. Figure 5-6 presents the full set of modeled flagpole receptor locations.

Figure 5-1 Stack and Building Locations for GEP Analysis

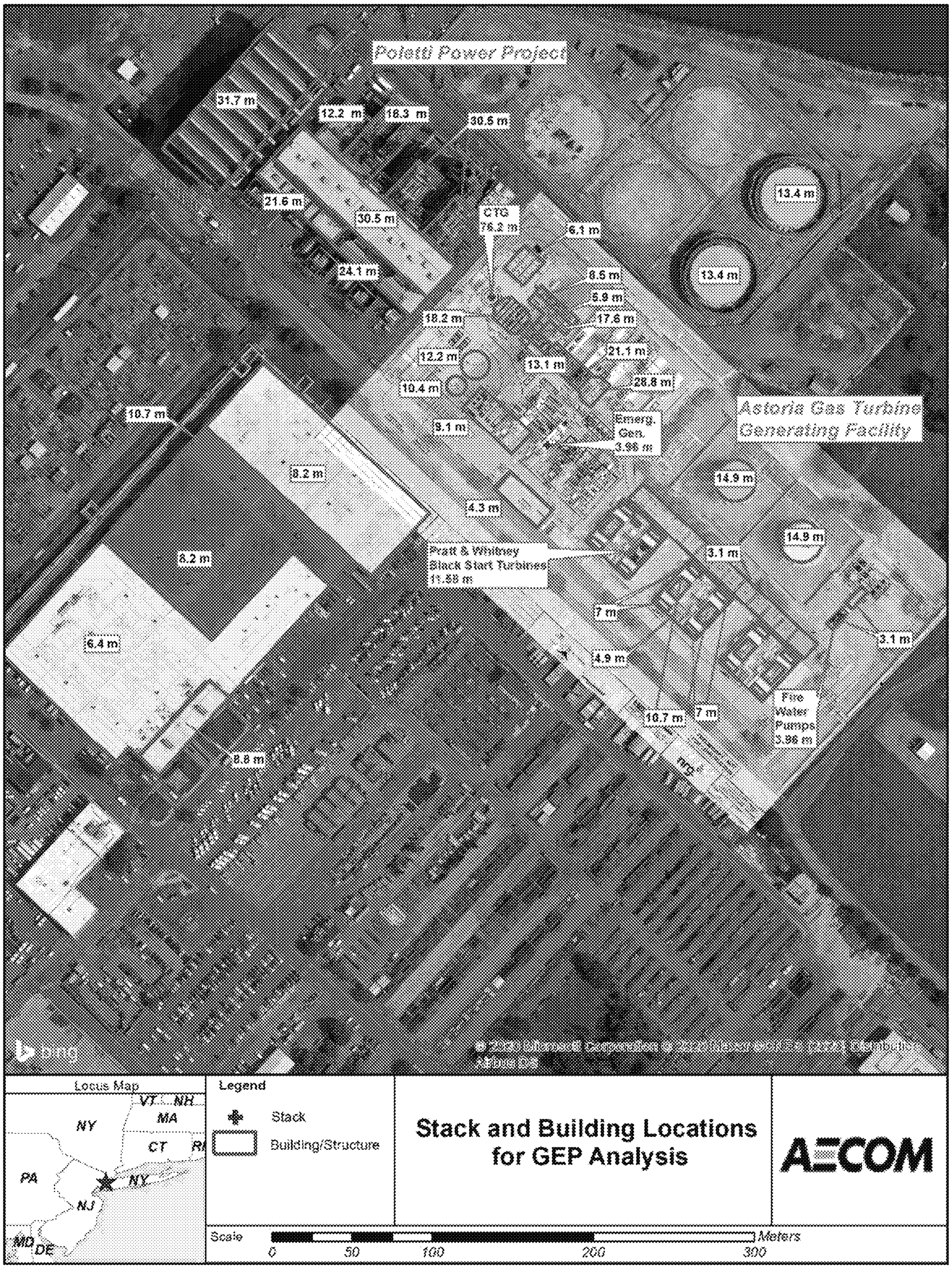


Figure 5-2 Land Use Surrounding the Astoria Facility

ED_013256A_00001460-00072

Figure 5-3 Counties within a 20-km Radius of the Facility

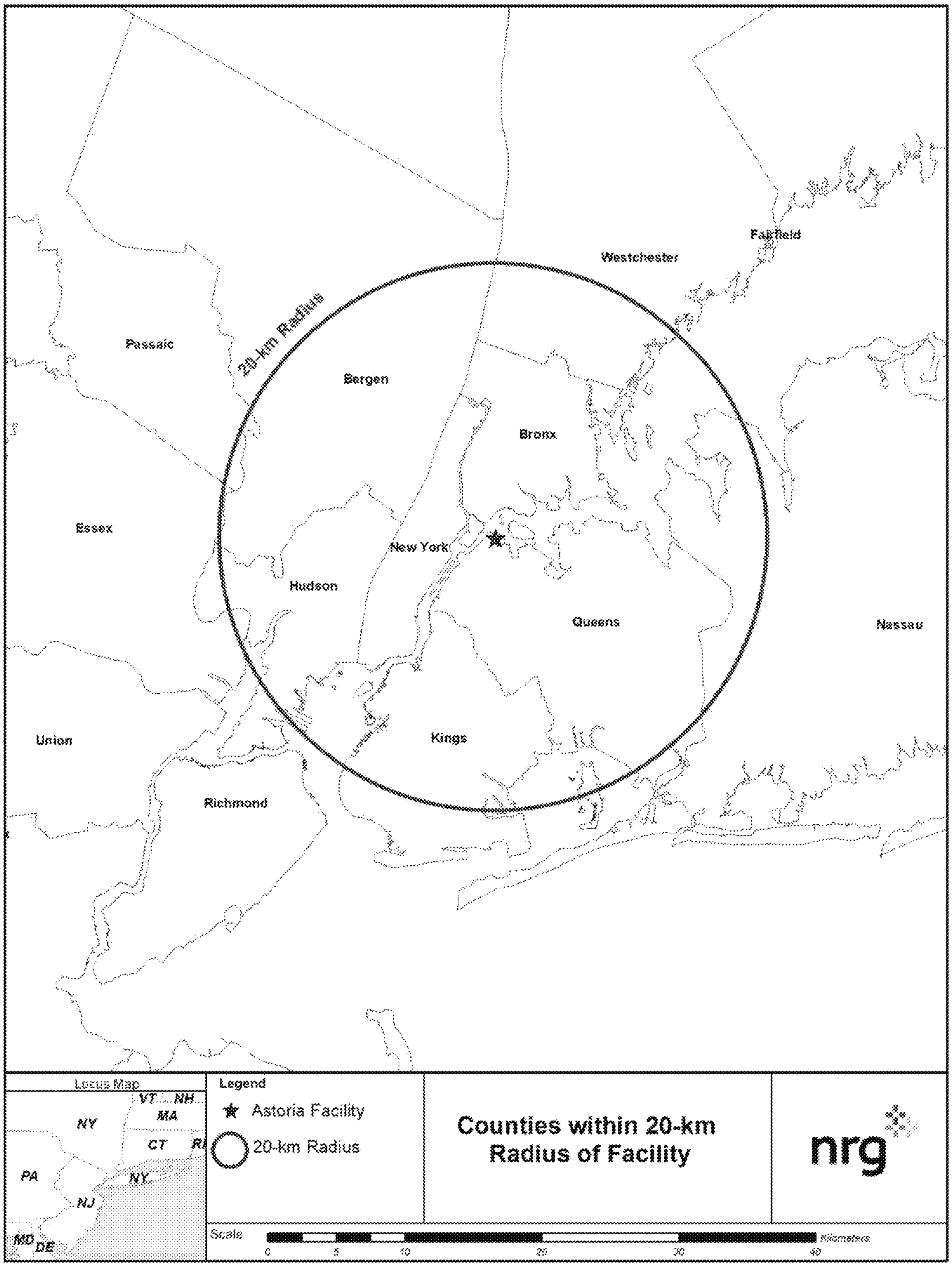
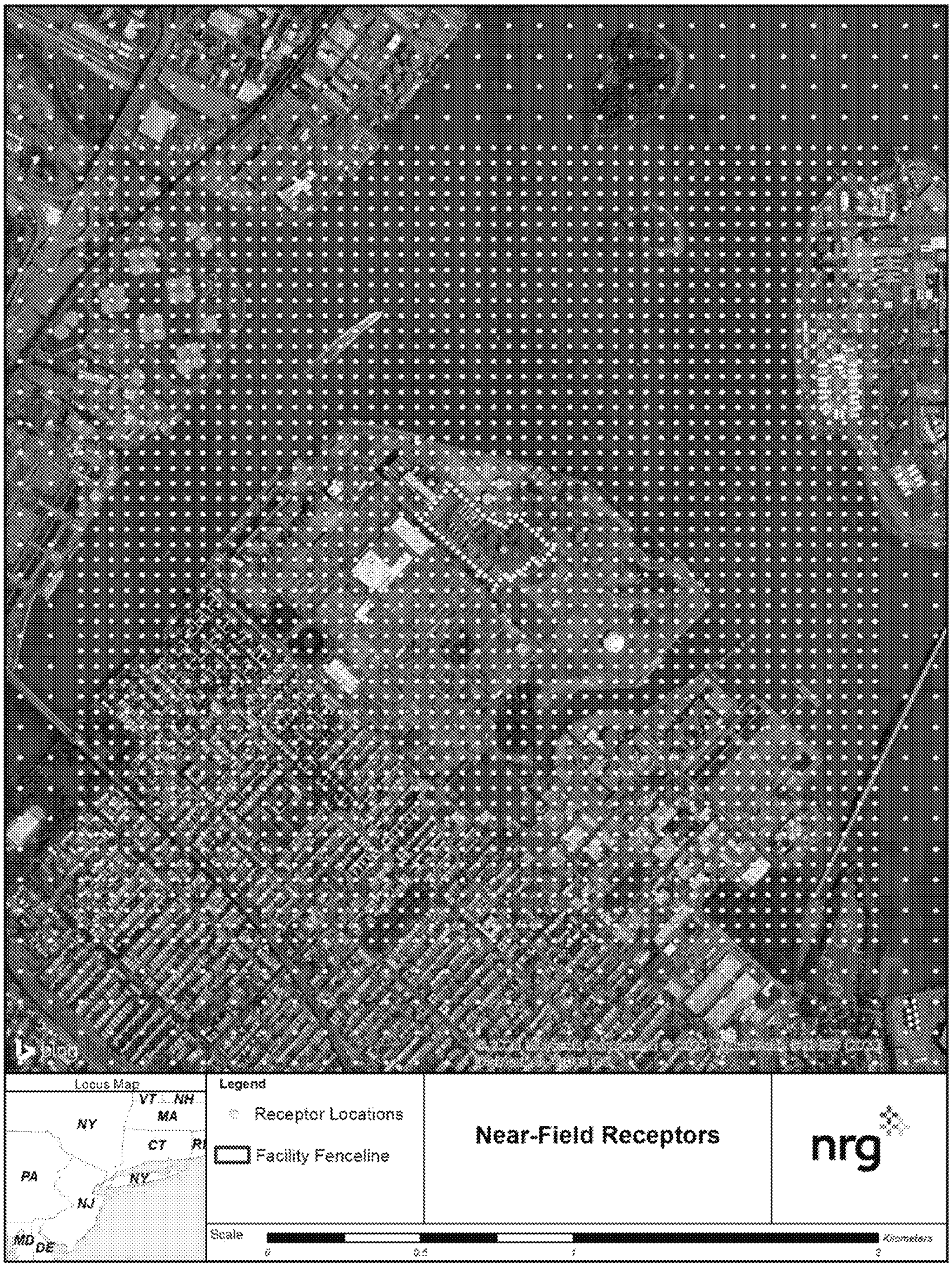


Figure 5-4 Near-field Receptors



ED_013256A_00001460-00074

Figure 5-5 Far-field Receptors

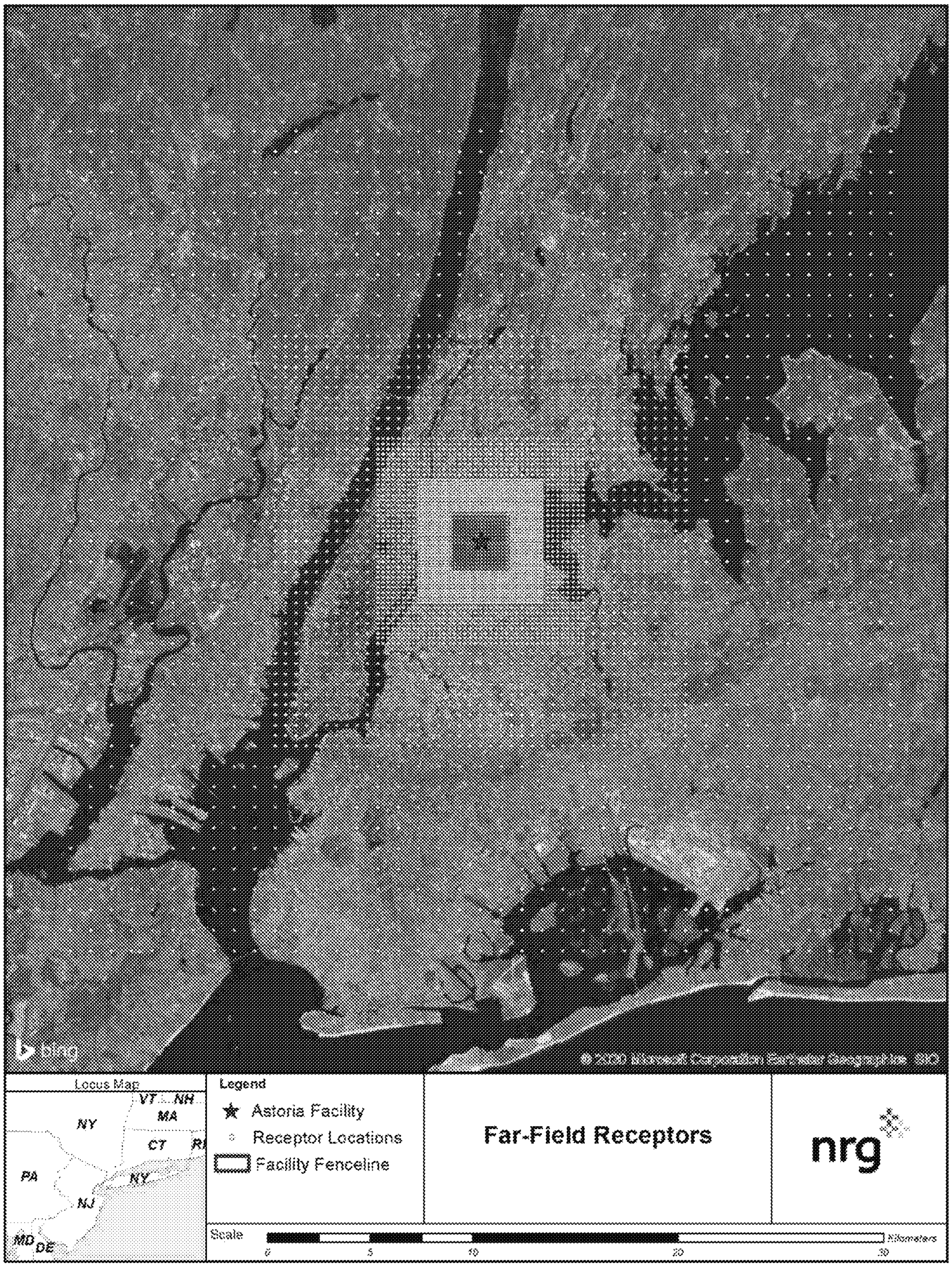
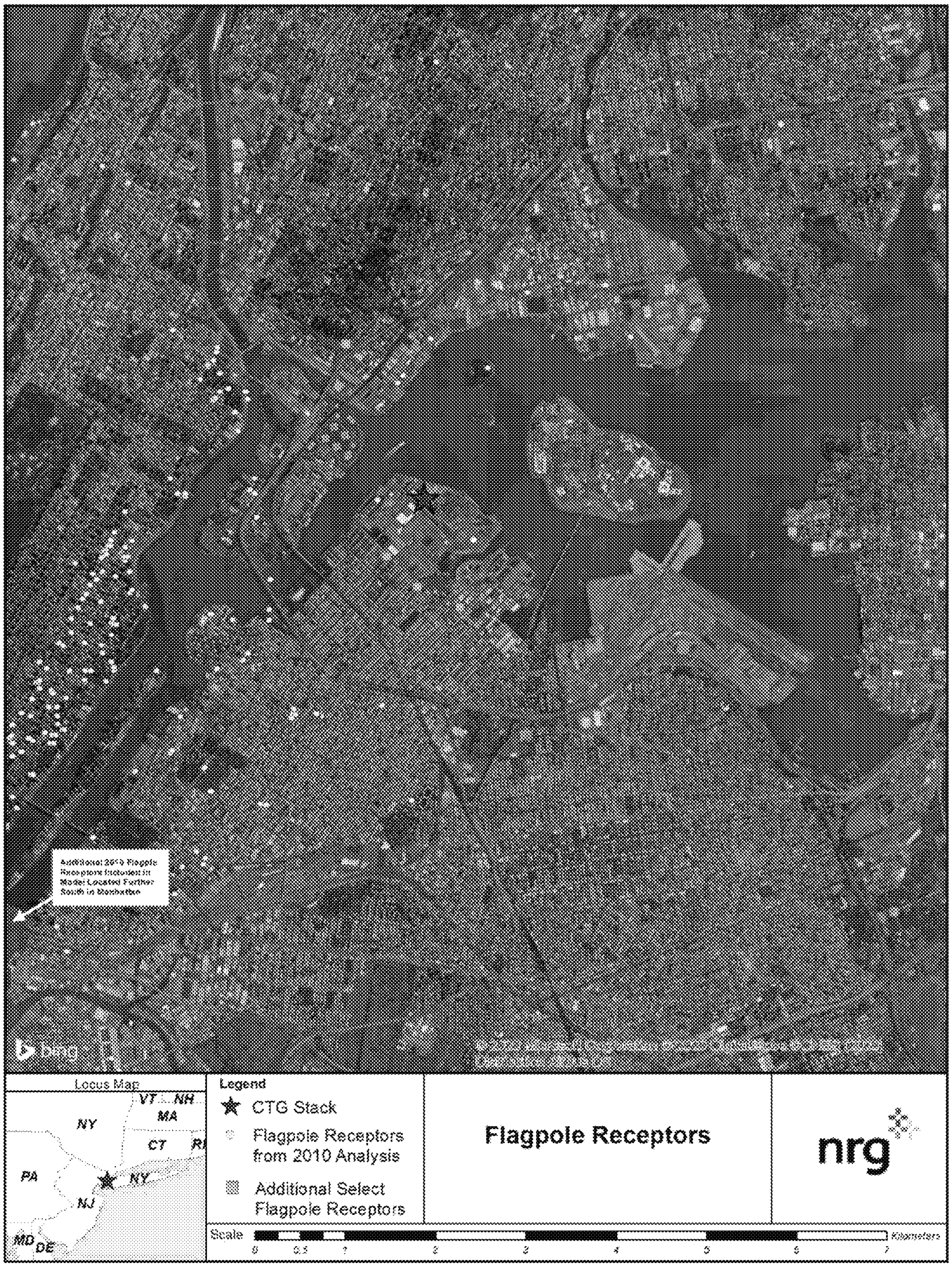


Figure 5-6 Flagpole Receptors



5.8 NO_2 Modeling

Based on current guidance (USEPA 2014), NO_2 impacts can be determined by using a three-tiered NO_X to NO_2 conversion rate system, where:

- Tier 1 assumes 100 percent NO to NO_2 conversion;
- Tier 2 utilizes the Ambient Ratio Method 2 ("ARM2") option in AERMOD; and
- Tier 3 allows the use of refined techniques such as the Ozone Limiting Method ("OLM") or the Plume Volume Molar Ratio Method ("PVMRM") which are both incorporated in AERMOD. PVMRM and OLM options in AERMOD account for ambient conversion of nitric oxide ("NO") to NO_2 in the presence of ozone based on the same basic chemical mechanism of ozone titration, the interaction of NO with ambient O_3 to form NO_2 and O_2. PVMRM is somewhat more advanced than OLM because it considers the plume volume and the moles of ozone available to mix with the moles of NO in the plume, hence the name.

The Tier 2/ARM2 option in AERMOD was used for this application.

5.9 Secondary $PM_{2.5}$

Since the Project is subject to PSD for $PM_{2.5}$, secondary $PM_{2.5}$ concentrations associated with Project NO_X and SO_2 precursor emissions was addressed. In April 2019, USEPA released the final *Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool for Ozone and $PM_{2.5}$ under the PSD Permitting Program* (USEPA 2019). This guidance replaces the draft MERP Guidance that was released in April 2016. The 2019 USEPA MERP Guidance provides a two-tiered approach for addressing single-source impacts on ozone and secondary $PM_{2.5}$. The first tier (Tier 1) involves use of appropriate and technically credible relationships between emissions and ambient impacts developed from existing modeling studies deemed sufficient for evaluating a project source's impacts. The second tier (Tier 2) involves more sophisticated case-specific application of chemical transport modeling (e.g., with an Eulerian grid or Lagrangian model). The Project based the secondary $PM_{2.5}$ impacts assessment on a Tier 1 analysis as described below.

Section 4.1.1 of the guidance provides several examples of MERP Tier 1 demonstrations for sources subject to PSD review. Because the Project emits primary $PM_{2.5}$, Scenario D was utilized to demonstrate that the combination of primary $PM_{2.5}$ emissions (modeled) and secondary $PM_{2.5}$ emissions (calculated) due to Project precursor emissions is estimated to result in a total impact less than the $PM_{2.5}$ SILs for both the 24-hour and annual averaging periods.

The primary $PM_{2.5}$ impact was determined for both the 24-hour and annual averaging periods using the maximum AERMOD impact (following procedures described herein) expressed as a percentage of the USEPA-recommended SIL.

Primary $PM_{2.5}$ 24-hour Impact =	**$PM_{2.5}$ 24-hour Conc. from AERMOD $\mu g/m^3$**	÷	**$PM_{2.5}$ 24-hour SIL (1.2) $\mu g/m^3$**	**x**	**100**
Primary $PM_{2.5}$ Annual Impact =	**$PM_{2.5}$ Annual Conc. from AERMOD $\mu g/m^3$**	÷	**$PM_{2.5}$ Annual SIL (0.2) $\mu g/m^3$**	**x**	**100**

The secondary $PM_{2.5}$ impact was determined by calculating the additive impacts due to the Project NO_X and SO_2 emissions, expressed as a percentage of the MERP for each precursor and then summed (separately for each of the 24-hour and annual averaging periods).

$$\text{Secondary } PM_{2.5} \text{ 24-hour Impact} = \left\{ \left(\frac{\text{Project } NO_X \text{ Emissions tpy}}{\text{Daily } NO_X\ PM_{2.5} \text{ MERP tpy}} \right) + \left(\frac{\text{Project } SO_2 \text{ Emissions tpy}}{\text{Daily } SO_2\ PM_{2.5} \text{ MERP tpy}} \right) \right\} \times 100$$

$$\text{Secondary } PM_{2.5} \text{ Annual Impact} = \left\{ \left(\frac{\text{Project } NO_X \text{ Emissions tpy}}{\text{Annual } NO_X\ PM_{2.5} \text{ MERP tpy}} \right) + \left(\frac{\text{Project } SO_2 \text{ Emissions tpy}}{\text{Annual } SO_2\ PM_{2.5} \text{ MERP tpy}} \right) \right\} \times 100$$

The MERP for each precursor was based on those calculated for hypothetical sources in USEPA's single-source photochemical modeling database (USEPA 2019). The lowest MERP from the 90-m stack source from Bronx County, NY was used., as shown below.

Precursor	Daily MERP(1)	Annual MERP(1)
SO_2	6,384	12,710
NO_X	30,204	128,059

Data source: USEPA database, Bronx County, NY 90-m stack source (USEPA 2019).

The total impact is presented in Section 5.12.2 as the sum of the direct $PM_{2.5}$ impact (percent) and secondary $PM_{2.5}$ impact (percent), for each of the 24-hour and annual averaging periods. In accordance with the USEPA guidance, since the sum is less than 100 percent, the estimated total $PM_{2.5}$ impact is considered insignificant (less than the SIL) and no additional modeling was required.

5.10 Background Air Quality and Pre-Construction Monitoring

5.10.1 Available Representative Data

In accordance with 40 CFR 52.21(m), an application for a PSD permit must contain an analysis of ambient air quality in the vicinity of the Project for each pollutant subject to PSD review. In addition, ambient air quality data are used to confirm that use of the SILs is appropriate by showing the difference between the background and the NAAQS is greater than the SILs.

Ambient background concentrations of criteria pollutants representative of the Facility and surrounding area are provided in Table 5-7. These data are from 2016-2018 and were obtained for the IS52 monitor located in Bronx County from the New York State Ambient Air Quality Reports (NYSDEC 2016b, 2017, 2018). The monitor location relative to the Facility is shown in Figure 5-6.

Table 5-7 Background Concentrations

Pollutant	Averaging Period	Monitoring Station ID	Location		Rank	Monitored Concentration (µg/m³)
			City, State	Distance (miles)		
$PM_{2.5}$	24-hour	36-005-0110	New York, NY	2	3 Year Avg. 98th Percentile	17.6
	Annual	36-005-0110	New York, NY	2	3 Year Avg. 1st High	7.6
PM_{10}	24-hour	36-005-0110	New York, NY	2	3 Year Max. 2nd High	32

Source: New York State Ambient Air Quality Reports for 2016–2018) https://www.dec.ny.gov/chemical/8536.html) (NYSDEC 2016b, 2017, 2018).

5.10.2 Pre-construction Monitoring

The PSD regulations require that a PSD permit application contain an analysis of existing air quality for all regulated pollutants that the source has the potential to emit in significant amounts. The definition of existing air quality can be satisfied by air measurements from either a state-operated or private network, or by a pre-construction monitoring program that is specifically designed to collect data in the vicinity of the proposed source. To fulfill the pre-construction monitoring requirement for PSD without conducting on-site monitoring a source may either:

1. Justify that data collected from existing monitoring sites are conservatively representative of the air quality in the vicinity of the project site; or
2. Demonstrate through modeling the ambient impacts from the project are less than the de minimis levels established by the USEPA.

The selected existing monitor is located in a similarly urbanized area as the Facility and therefore should be a good representation of the air quality in the vicinity of the Project. Furthermore, Project modeling results in Section 5.12.2 indicate impacts are less than the de minimis levels for PSD-applicable pollutants (shown in Table 5-8).

Table 5-8 De Minimis Monitoring Concentrations

Pollutant	Averaging Time	
	Annual ($\mu g/m^3$)	24-hour ($\mu g/m^3$)
PM_{10}	-	10

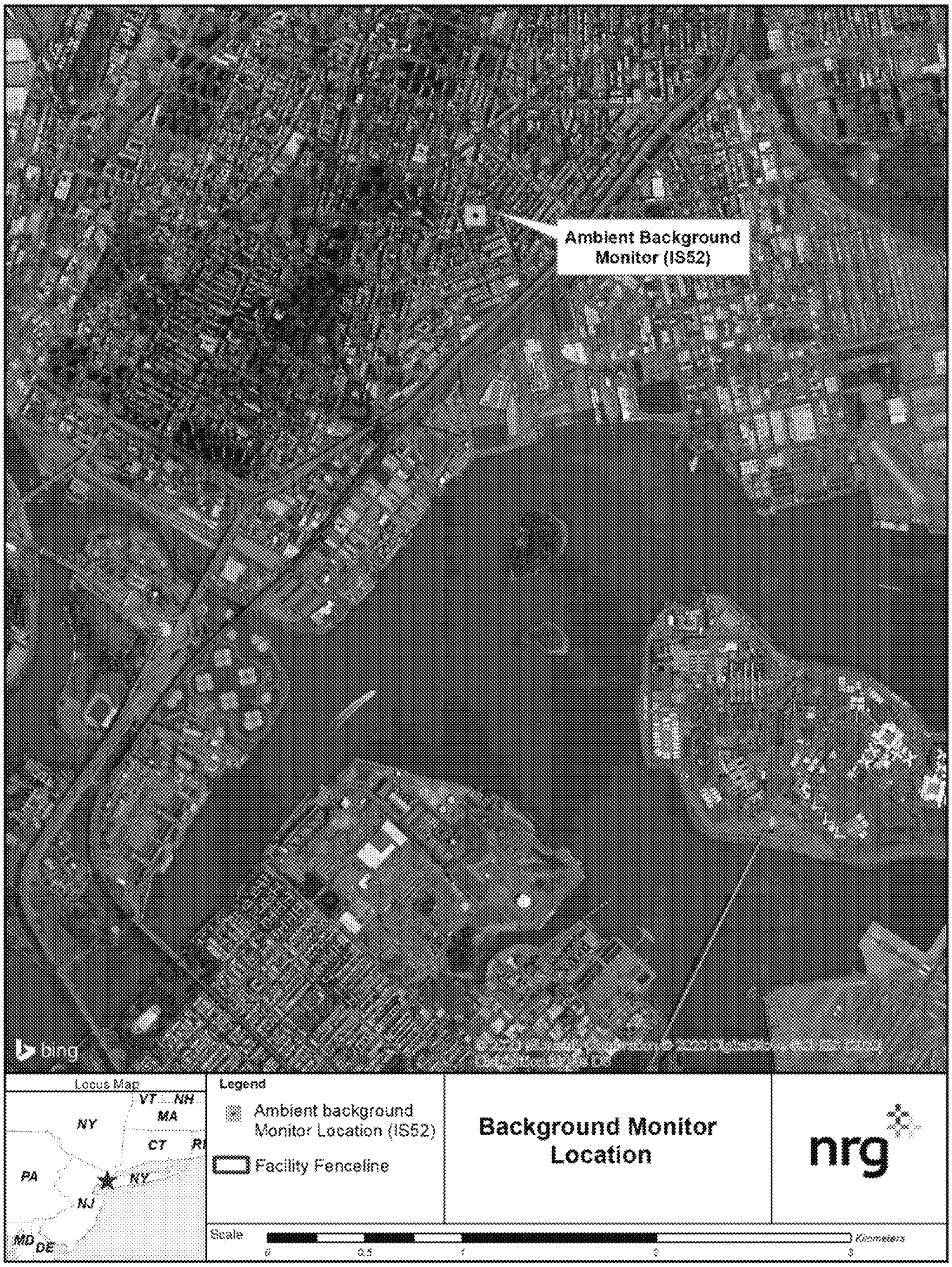
5.11 Class II Area Significant Impact Level Analysis Results

In this section, results of the air quality impact analyses for the Project alone are presented. These air quality analyses were conducted using the inputs and methodologies described in the preceding sections of this report. Discussions to be found in this section include the estimated impacts of the Project as they relate to SILs. All modeling input and output files are included on the modeling archive submitted to NYSDEC with this application.

5.11.1 Determination of Maximum Impact Scenarios for the CTG

Initial modeling was conducted for the CTG alone to determine the maximum impact steady-state operating scenarios for each pollutant and averaging period based on modeling conducted for each of the 30 scenarios presented in Tables 5-1 and 5-2. The detailed modeling results for this analysis are provided in Appendix E. These results were reviewed to identify the maximum impact case for each pollutant and averaging period for steady-state operations and SU/SD to formulate the composite SIL modeling cases for short-term modeling summarized in Table 5-9 (see Table 5-3 for annual modeling scenarios and source data).

Figure 5-7 Background Monitor Location



5.11.2 Significant Impact Analysis

AERMOD was applied with the 5-years of meteorological data to determine the maximum modeled concentrations of the Project sources (CTG, emergency generator, and two fire system pump engines) for comparison to the SILs. A summary of the overall maximum Project impacts is provided in Table 5-10. All maximum impacts were modeling in areas where receptor spacing was no greater than 50 meters, and therefore additional modeling to further resolve the modeled concentrations was not required.

As shown in Table 5-10, the maximum modeled impacts for the Project are below all SILs, therefore, demonstrating compliance with the NAAQS and PSD Class II increments and no further analysis was required. In addition, Table 5-11 presents the total $PM_{2.5}$ impact, including secondary $PM_{2.5}$, shown as the sum of the direct $PM_{2.5}$ impact (percent) and secondary $PM_{2.5}$ impact (percent), for each of the 24-hour and annual averaging periods. In accordance with the USEPA guidance, since the sum is less than 100%, the estimated total $PM_{2.5}$ impact is considered insignificant (less than the SIL) and no additional modeling was required.

Lastly, the modeling results for the Project are below the significant monitoring concentrations for 24-hour PM_{10} (10 $\mu g/m^3$).

Table 5-9 Composite Cases with Steady-state(1) and SU/SD Emission Rates and Stack Parameters for Short-term SIL Modeling(2)

									Short-Term Emissions(1) (g/sec)							
Operational Case	Fuel	Load	Ambient Temp. (°F)	Duration (min)	Stack Height (m)	Stack Temp. (°K)	Stack Velocity (m/sec)	Stack Diam. (m)	CO 1-Hour	CO 8-Hour	NO_X 1-Hour	$PM_{2.5}$ 24-Hour	PM_{10} 24-Hour	SO_2 1-Hour	SO_2 3-Hour	SO_2 24-Hour
Case 56 (Steady-state)	ULSD	50%	100	40	76.2	722.1	28.2	8.69	-	-	-	5.75E+00	5.75E+00	-	-	-
SU(2)	ULSD	Start-up	100	20	76.2	718.8	17.9	8.69	-	-	-	3.15E+00	3.15E+00	-	-	-
Case 80 (Steady-state)	ULSD	Base	-5	40	76.2	722.1	39.9	8.69	3.97E+00	3.97E+00	6.52E+00	-	-	5.15E-01	5.15E-01	5.15E-01
SU(2)	ULSD	Start-up	-5	20	76.2	716.3	18.2	8.69	5.42E+01	5.42E+01	2.90E+01	-	-	3.28E-01	3.28E-01	3.28E-01

(1) Steady-state operation emission rates pro-rated to 40 minutes of operation.

(2) Case selected based on highest modeled concentration from load analysis presented in Appendix E.

Table 5-10 Project Sources Alone – SIL Modeling Results

Pollutant	Averaging Period	Maximum Modeled AERMOD Concentrations for Project Sources (µg/m³)		Significant Impact Level (µg/m³)
		Ground Receptors	Flagpole Receptors	
NO_2	1-hr	6.48	5.68	7.5
	Annual	0.88	0.05	1
CO	1-hour	833	71	2,000
	8-hour	51	10	500
PM_{10}	24-hour	0.68	0.50	5
	Annual	0.06	0.01	1
$PM_{2.5}$ (1)	24-hour	0.45	0.41	1.2
	Annual	0.05	0.01	0.3
SO_2	1-hour	0.13	0.12	7.9
	3-hour	1.84	0.15	25
	24-hour	0.06	0.04	5
	Annual	0.002	0.001	1

(1) Includes only primary $PM_{2.5}$ impact. See Table 5-11 for calculation of total $PM_{2.5}$ impacts including secondary component.

Table 5-11 Total PM2.5 Impacts – Primary plus Secondary

Averaging Period	Primary $PM_{2.5}$ Impact Calculation			Secondary $PM_{2.5}$ Impact Calculation							Total Primary + Secondary $PM_{2.5}$ Impact (% of SIL)
	Maximum AERMOD Concentration ($\mu g/m^3$)	SIL ($\mu g/m^3$)	Primary Impact (% of SIL)	Project Potential NO_X Emissions (tpy)	NO_X MERPS[(1)] (tpy)	Impact from NO_X Precursors (% of SIL)	Project Potential SO_2 Emissions (tpy)	SO_2 MERPS[(1)] (tpy)	Impact from SO_2 Precursors (% of SIL)	Total $PM_{2.5}$ Secondary Impact (% of SIL)	
24-hour	0.45	1.2	37.58%	100.5	30204	0.33%	7.9	6384	0.12%	0.46%	38.04%
Annual	0.05	0.2	26.40%	100.5	128059	0.08%	7.9	12710	0.06%	0.14%	26.54%

(1) Hypothetical source from USEPA database (USEPA 2019), lowest MERP for Bronx, NY source (90 m stack height).

5.12 Air Toxics Modeling

Modeling of the Project emissions was also conducted for air toxic compounds in accordance with NYSDEC's DAR-1 for evaluating air toxic compounds relative to the SGCs and AGCs.

Modeling of air toxic emissions was conducted for emissions from the CTG, emergency generator, two fire-system pump engines and P&W Twin Pac turbines being retained for black-start service. The results of the analysis are summarized in Table 5-12 and represent the maximum concentrations across all receptors, both ground level and flagpole. Appendix E presents the results for the ground level and flagpole receptors individually.

A screening approach was used to model all Project sources a unit emission rate (1 g/sec) in AERMOD for individual runs for each source and combine the highest impacts over the five years of meteorology modeled for all sources. This is extremely conservative since the highest impacts for each source do not necessarily occur at the same receptor or during same meteorological data time period.

As shown in Table 5-12, all of the total modeled Project concentrations are below the SCGs and AGCs.

Table 5-12 Air Toxics Modeling Results

HAP	Modeled 1-hour Concentration(1) (µg/m^3)	SGC (µg/m^3)	% of SGC	Modeled Annual Concentration(1) (µg/m^3)	AGC (µg/m^3)	% of AGC
1, 3 Butadine	4.98E-02	N/A	-	4.77E-05	3.30E-02	0.1%
Acetaldehyde	3.54E-01	470	<0.1%	8.95E-04	4.50E-01	0.2%
Acrolein	4.82E-02	2.5	2%	1.14E-04	3.50E-01	<0.1%
Arsenic	2.58E-02	N/A	-	4.47E-06	2.30E-04	2%
Benzene	7.35E-01	1300	<0.1%	1.92E-03	1.30E-01	1%
Beryllium	7.26E-04	N/A	-	1.26E-07	4.20E-04	<0.1%
Cadmium	1.08E-02	N/A	-	1.87E-06	2.40E-04	1%
Chromium	2.58E-02	N/A	-	4.47E-06	45	<0.1%
Ethylbenzene	7.39E-02	N/A	-	7.46E-06	1000	<0.1%
Formaldehyde	2.06E+00	30	7%	1.63E-03	6.00E-02	3%
Lead	3.28E-02	N/A	-	5.69E-06	3.80E-02	<0.1%
Manganese	1.85E+00	N/A	-	3.21E-04	5.00E-02	1%
Mercury	2.81E-03	6.00E-01	0.5%	4.88E-07	3.00E-01	<0.1%
Naphthalene(2)	1.59E-01	7900	<0.1%	2.48E-04	3	<0.1%
Nickel	1.08E-02	2.00E-01	5%	1.87E-06	4.20E-03	<0.1%
PAH	2.30E-01	N/A	-	4.34E-04	2.00E-02	2%
Propylene Oxide	6.69E-02	3100	<0.1%	6.76E-06	2.70E-01	<0.1%
Selenium	5.86E-02	N/A	-	1.02E-05	20	<0.1%
Toluene	5.44E-01	37000	<0.1%	7.99E-04	5000	<0.1%
Xylenes	3.16E-01	22000	<0.1%	5.48E-04	100	<0.1%

N/A = Not SGC/AGC listed.

(1) Maximum modeled concentration at either ground-level or flagpole receptors.

(2) NYSDEC DAR-1 (2016a) indicates that the Naphthalene SGC is based on American Conference of Governmental Industrial Hygienists (ACGIH) short-term exposure limit (STEL), which is an occupational health standard. As a result, the Agency for Toxic Substances and Disease Registry (ATSDR) and other sources of short-term, health-based comparison values were consulted for a potential alternate threshold to use in the analysis. US Department of Energy's Protective Action Criteria (PAC-1) provided the same value as the DAR-1 SGC. No other sources, including ATSDR, listed a short-term threshold.

5.13 Additional Impact Analysis

Additional impacts must be addressed for projects subject to PSD review. The various components of the additional impact analyses are discussed below.

5.13.1 PSD Class I Area Analyses

The closest Class I area is the Brigantine National Wildlife Refuge approximately 150 km to the south of the Facility in southern New Jersey on the Atlantic Coast. Conservative screening modeling was conducted with AERMOD to demonstrate insignificant impacts relative to the Class I Area SILs. The analysis utilized a ring of receptors (full circle of receptors) at a distance of 50 km from the Facility (i.e., practical limit of AERMOD). Table 5-13 presents modeling results that are all lower than the Class I SILs, demonstrating the Project will have an insignificant impact on the Class I area.

The Federal Land Managers' Air Quality Related Values Work Group Phase 1 Report (Revised 2010) (FLAG 2010) guidance document, references a Q/D screening approach that is designed to screen out projects from the need to conduct an Air Quality Related Values ("AQRV") analysis for Class I areas located more than 50 km away. The Q in the Q/D is the sum of the short-term NO_X, SO_2, H_2SO_4, and PM emissions expressed in tpy, and D is the distance in km from the project to the Class I area. The FLAG guidance suggests that if the Q/D ratio is less than ten, the FLM may decide that an analysis of AQRVs (including regional haze and acid deposition) is not necessary.

As noted in Section 3, the Project will result in a net decrease in NO_X emissions and emission increases of SO_2 and H_2SO_4 that are less than PSD SPTs given the use of low sulfur fuels (natural gas and ULSD). Therefore, for this Project Q was based on PM_{10}/$PM_{2.5}$ emissions associated with normal CTG operations (worst-case fuel being ULSD). Other project sources normally operate very intermittently (i.e. less than 500 hours per year) for testing purposes only and were therefore not included in the determination of Q.

Table 5-14 provides the inputs to the Q/D analysis which includes a Total Q of 312 tons and the distance from the Project to Brigantine Wildlife Refuge of 150 km. This results in a Q/D of 2.1, which is much less than the FLAG screening threshold of 10. Based on this ratio, Astoria has prepared a Request for Applicability of Class I Area Modeling Analysis which was submitted for review by the Fish and Wildlife Service ("FWS") to confirm that Class I AQRV modeling will not be required (see Appendix G). Astoria has yet to receive a response from the FWS. Astoria anticipates the FLM approving the waiver request and is not planning on assessing AQRVs at Brigantine Wildlife Refuge.

Table 5-13 PSD Class I SIL Analysis

Pollutant	Averaging Period	Maximum Modeled AERMOD Concentrations ($\mu g/m^3$)	Class I Significant Impact Level ($\mu g/m^3$)
PM_{10}	24-hour	0.08	0.3
	Annual	0.001	0.2
$PM_{2.5}$	24-hour	0.06	0.07
	Annual	0.001	0.06

Table 5-14 Class I Q/D Analysis

Source	PM_{10} / $PM_{2.5}$ Emissions	
	lb/hr(1)	tpy(2)
CTG	71.1	311.4
Distance to Brigantine Wildlife Refuge (km)	**150**	
Q/D	**2.1**	
(1) See Table 2-1. (2) Equivalent tpy based on the maximum lb/hr emissions.		

5.13.2 Growth Analysis

A qualitative assessment was made as to the Project's potential to cause general commercial, residential, industrial or other secondary growth in the area. If substantial growth due to this Project were expected, an assessment of associated air quality impacts would be required. However, the Project is the replacement of existing sources and expected to be operated by employees currently working at the Facility, so additional housing or infrastructure is not necessary to support the Project. Likewise, no secondary industrial growth is anticipated as the necessary support industry is already in place. Therefore, secondary growth from the Project is not expected to be substantial, and thus an analysis of such growth was not conducted for this Project.

5.13.3 Soils and Vegetation Analysis

The screening criteria for evaluating impacts on soils and vegetation are provided in USEPA's *A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils and Animals* (USEPA 1980). Of those criteria, only analysis of PM_{10} is required because no other pollutant listed in USEPA 1980 qualifies for PSD review. As shown in Table 5-14, the maximum modeled PM_{10} concentrations from the Project are well below the screening criteria. In addition, it is noted that as shown in Table 5-10, all modeled pollutant concentrations for the Project are well below the SILs which are more stringent than the screening criteria. Therefore, the Project will not cause an adverse impact to sensitive vegetation, crops, or soil systems.

Table 5-15 Soils and Vegetation Analysis

Pollutant	Averaging Period	Maximum Impact of Proposed Project ($\mu g/m^3$)	Minimum Impact Level for Effects on Sensitive Plants ($\mu g/m^3$) (1)
PM_{10}	24-Hour	0.68	150
(1) USEPA 1980.			

5.14 Modeling Results Summary

In summary, the modeled concentrations for Project are below the Class I and II SILs for criteria pollutants thus demonstrating compliance with the NAAQS and PSD increments. In addition, the modeled concentrations for air toxic compounds are below all SGCs/AGCs indicating no potential for adverse health impacts due to Project air emissions.

6.0 Climate Leadership and Community Protection Act

6.1 GHG Emission Limits and Targets

The CLCPA (Chapter 106 of the Laws of 2019) and Article 75 of the Environmental Conservation Law ("ECL"), requires NYSDEC to promulgate regulations to establish a statewide GHG emissions limit for 2030 that is sixty percent of 1990 GHG emissions, and for 2050 that is fifteen percent of 1990 GHG emissions. The CLCPA requires that CO_2e emissions be calculated based on a 20-year global warming potential ("GWP") for GHGs that are not CO_2, as opposed to either the 100-year GWP used by the Intergovernmental Panel on Climate Change ("IPCC") or the GWPs required by 6 NYCRR 231-13.9 that are used for permitting . The CLCPA also amended the Public Service Law to require the Public Service Commission ("PSC" or "Commission") to establish a program to meet a target of seventy percent of statewide electrical generation from renewable sources by 2030, and a target of zero GHG emissions for statewide electrical demand by 2040. The regulations and programs to be implemented by NYSDEC and the Commission in accordance with the CLCPA are to be conducted in a manner that minimizes costs and maximizes benefits.

NYSDEC recently adopted 6 NYCRR Part 496, which limits Statewide Greenhouse Gas Emissions in 2030 and 2050 as a percentage of 1990 emissions, per the requirements of the CLCPA. As such, Part 496 limits Statewide Greenhouse Gases in 2030 to 245.87 million metric tons of CO_2e, and 61.47 tons in 2050. Part 496 also includes the 20-year global warming potentials for GHGs that are not CO_2. The rule applies to all emission sources in New York State, but does not itself impose compliance obligations. The final rule was published in the New York State Register on December 30, 2020. The Part 496 statewide emission limits will serve as the baseline for the promulgation of future NYSDEC CLCPA regulations for attainment of the 2030 and 2050 limits. NYSDEC also finalized its *Establishing a Value of Carbon Guidelines for Use by State Agencies* guidance on December 30, 2020, which is for use by State agencies to monetize benefits/costs of actions that impact GHG emissions based on societal impacts incurred as a result of climate change.

Section 7(2) of the CLCPA also requires all state agencies to consider whether its decision to issue permit(s) is inconsistent with or will interfere with the attainment of the statewide GHG emission limits established in ECL Article 75. Where such decisions are deemed to be inconsistent with or will interfere with the attainment of the statewide GHG limits, the agency must provide a detailed statement of justification as to why such limits/criteria may not be met and identify alternatives or GHG mitigation measures to be required where the project is located.

Section 6.1.2 provides a summary of the Project's direct and indirect maximum and expected GHG emissions in CO_2e using the 20-year global warming potentials adopted in 6 NYCRR 496.5 ("GWP20"). A full assessment and discussion of the Project's maximum permitted and expected direct and indirect GHG emissions is provided in the draft supplemental environmental impact statement ("DSEIS"), revised April 2021.

Based on the CLCPA and Part 496 definitions of "Statewide Greenhouse Gas Emissions," the assessment of the Project's impact on Statewide Greenhouse Gas Emissions includes: direct GHG emissions produced inside of the State; GHG emissions produced outside of the State associated with electricity imported into the State; and, extraction and transmission of fossil fuels imported into the State.

6.1.1 Project Consistency

The Project is consistent with the limits, targets, and goals of the CLCPA. It will not only not interfere with the attainment of statewide GHG limits, but instead plays a key role in New York meeting the GHG reductions established by the CLCPA.

The Project is consistent with the limits, targets and goals of the CLCPA, Article 75 and Part 496 as it:

A. Immediately Results in Direct GHG Emission Reductions Through Increased Turbine Efficiency

The Project is proposing to use an H-class combustion turbine, which is the most efficient combustion turbine in its size range commercially available today. As a result, the Project will generate electricity using less fuel than many existing electric generating units in service today. Since the NYISO dispatches the bulk power system based on the next most efficient resource, the Project will displace older, less efficient generation resulting in a net reduction in direct GHG emissions.

To quantify the Project's reduction of direct GHG emissions, a comprehensive system dispatch model was developed using the new unit's dispatch modeled against expected future market conditions (see Navigant/Guidehouse GHG Report and Supplement in **Appendix F)**. Determining the impact of the Project requires the dispatch model to be run with and without the new unit. In all cases The Navigant/Guidehouse analysis assumes the existing units retire on April 30, 2023. As a result, the dispatch analysis does not include any GHG emission reductions resulting from retirement of the existing units (i.e., the baseline for the analysis does not include the existing units). Similarly, dispatch cases which include the Project assume it begins commercial operations (generating electricity for the grid) in June 2023.

The dispatch analysis forecasts the Project will result in direct CO_2 emission reductions from displacement of other electric generating units of over 72,000 and 88,000 tons annually in 2023 and 2024 when the new unit first comes online. These benefits include the impacts of GHG emissions associated with electricity imported into the State. As the NYISO system integrates a growing amount of renewable resources to achieve the CLCPA's zero-carbon energy system target, the Project's capacity factor declines thereby reducing the direct annual CO_2 benefit to 21,000 tons in 2030 and 5,000 tons in 2035. When direct non-CO_2 GHGs and upstream emissions associated with extraction and transmission of fuels are included, the direct GHG benefits of the Project are even greater; see Table 6-1, Table 6-2 and Table 6-3.

Table 6-1 Annual GHG Emissions Reductions due to the Project (000 Tons)

Year	GHG Emissions Reduction (GWP20)(1)(2)			Cumulative GHG Emissions Reduction (GWP20)
	Direct	Indirect		
		Increase in Renewable Generation	Upstream	
2023	72	--	32	104
2024	88	--	40	232
2025	57	--	24	314
2026	38	--	17	369
2027	40	--	18	427
2028	18	--	8	453
2029	27	--	12	492
2030	21	476	9	998
2031	15	646	7	1,666
2032	19	782	8	2,476
2033	7	979	3	3,464
2034	13	961	6	4,444
2035	5	990	2	5,441
Cumulative Total	**421**	**4,834**	**186**	**5,441**

(1) Direct - emissions reduction associated with the displacement of less efficient units, including displacement of units outside of the state associated with the generation of electricity imported into the state, by the highly efficient Project CTG which will generate electricity using less fuel.
Indirect (Increase in Renewable Generation) - emissions reduction associated with the Project allowing for an accelerated increase in renewable generation on the electric system by: providing economic backup electricity when renewable resources are unavailable and/or battery storage resources are insufficient; and, allowing a large amount of energy storage investment to be avoided and used to increase renewable generation.
Indirect (Upstream) - emissions reduction associated with decreasing upstream emissions associated with the production and transport of fuel used by the electric system to produce electricity.
(2) All values based on GWP20, as adopted in 6 NYCRR 496.
(3) Additional information, and breakdown of GHGs available in **Appendix I**, Table 6-2 and Table 6-3.

Although the generation output of the new unit declines over time as renewable resources are added to the electric system, and direct and upstream GHG reductions correspondingly decline, the new unit will remain a key resource in providing multiple system needs required for reliability and operability of the electric system. As a modern combustion turbine with quick start and fast ramping capability, the Project is well equipped to provide additional quick response capability to account for unexpected variations in renewable generation and additional fast ramping capability to meet future daily demand when renewable resources are unavailable (e.g., when the sun sets during evening peak load periods). The Project also will mitigate energy prices during severe weather events and provide fuel security when natural gas must be prioritized for residential and commercial heating.

B. Results in Indirect Reduction in GHG Emissions

In addition to direct reductions in GHG emissions, the Project will also be responsible for further GHG emission reductions by (1) decreasing upstream emissions associated with the production and transport of fuel used by the electric system to produce electricity, and (2) allowing for an increase in renewable generation on the electric system by providing needed backup electricity when renewable resources are unavailable or battery storage resources are insufficient.

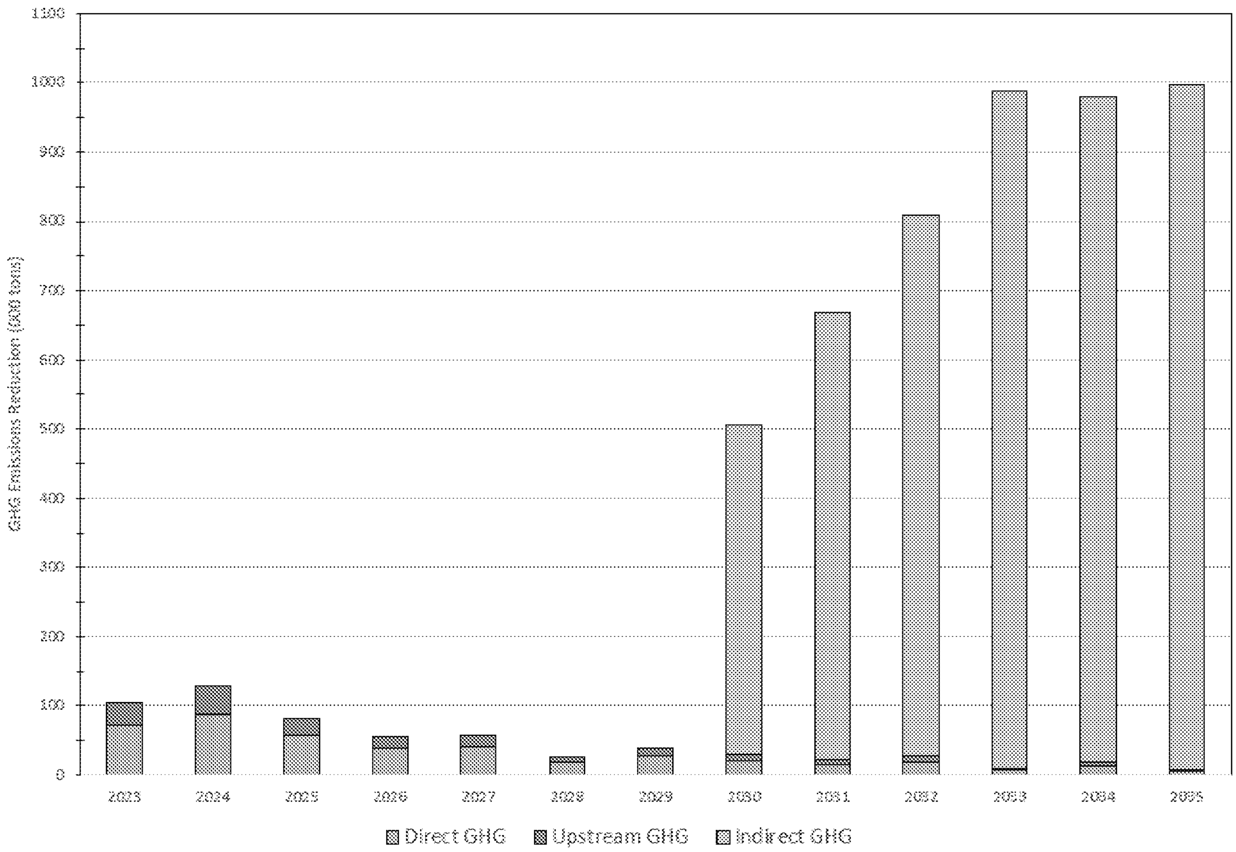
The Project's efficiency will cause a decrease in upstream emissions from the electric system by displacing generating units that are less efficient and therefore use more fuel to produce the same amount of power. The average decrease in upstream GHG emissions from the electric system caused by the Project are estimated to be 14,298 tons per year on average during the 2023-2035 timeframe (see Table 6-1 and Table 6-5).

As explained above, the new unit's quick start and fast ramping ability also allows for an increase of renewable generation on the New York State and New York City electrical system by providing needed backup supply when renewable resources are unavailable and/or when battery storage resources are insufficient. In addition, as overall system decarbonization accelerates, the Project provides indirect GHG emission reductions by providing economic capacity and flexible operating capabilities to the system allowing a large amount of energy storage additions to be avoided (Section 5.2 of the Navigant/Guidehouse GHG Report, and Section 3 of the Supplement, both in **Appendix F**). The monetary savings from avoiding the storage investment can be used to both reduce costs for ratepayers and accelerate procurement of downstate renewable energy projects, which leads to large indirect GHG reductions, particularly during the 2030-2040 time period when the electrical system is rapidly transitioning to meet CLCPA targets. These indirect GHG emissions reductions from the Project during the 2030-2035 timeframe are estimated to be between 476,000-990,000 tons per year see Table 6-1 and Figure 6-1.

As further explanation, in the mid to longer-term (2030-2040), a meaningful portion of the capacity needed in New York City to backup intermittent renewable generation is expected to be provided by battery storage systems. However, an important role remains for a small amount of low emission gas-fired generation to maximize GHG reductions on the system at minimal cost – particularly during the final transition to a zero-carbon electrical system in 2040. In an electrical system with battery storage providing most or all of the needed marginal capacity, the battery storage resources will require longer duration capability to provide the same capacity value. Since longer duration battery systems are significantly more expensive, as the amount of battery storage on the system increases and the amount of natural gas generation decreases, the cost to provide reliable electric service goes up (Section 5.2.2 of the Navigant/Guidehouse GHG Report, and Section 3 of the Supplement, both included in **Appendix F**).

The ability of limited, efficient, gas-fired generation to lower system costs can be used to accelerate additional renewable resources being brought onto the system. If half of New York City's current peaking resources were replaced with battery storage, the battery storage cost would be $6,240/kW, whereas the cost for a combustion turbine to provide the same capacity value, and the backstop needed to allow increased renewables on the system, would be $1,154/kW (less than 20% of the equivalent battery storage cost). These cost savings can then be used to accelerate wind or solar resources to replace existing intermediate and baseload fossil-fuel fired electric generation, resulting in significant additional GHG emission reductions that would far outweigh the GHGs from the Project in a manner maximizing benefits and minimizing costs as required by the CLCPA (see Section 5.2.2 of the Navigant/Guidehouse GHG Report, and Section 3.2 of the Supplement, in **Appendix F**).

Figure 6-1 GHG Reduction Benefits of Astoria Replacement Project

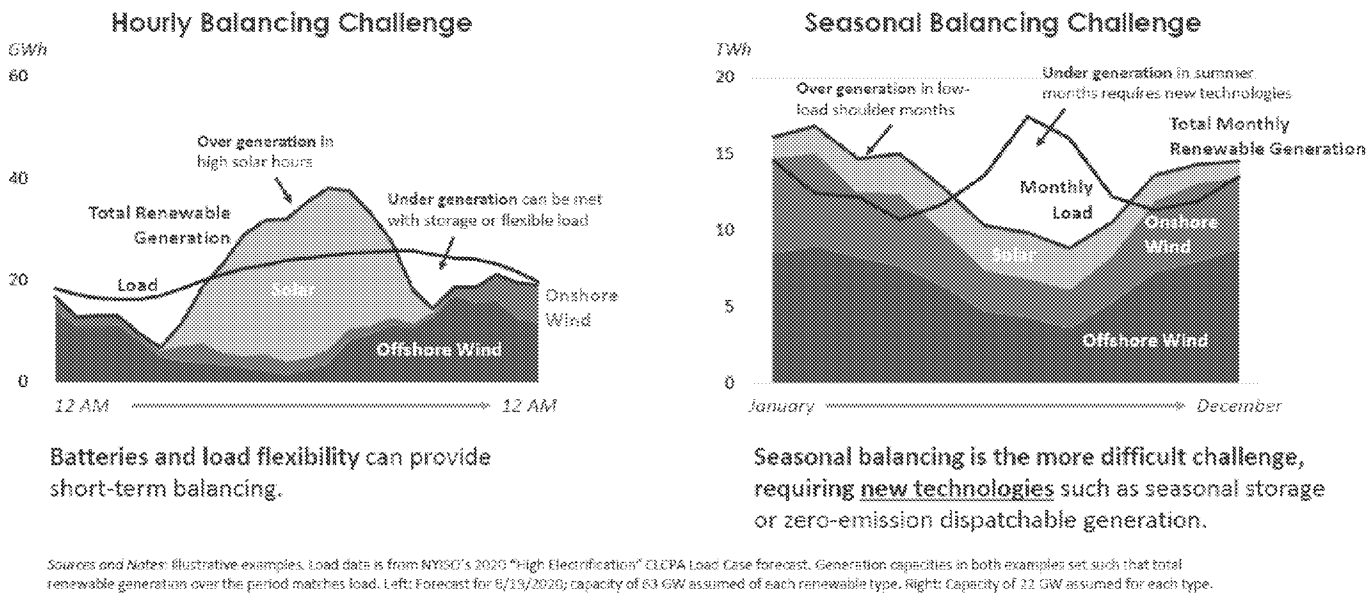


C. Facilitates the Reliable Transition to a Zero Carbon Electric Grid

The NYISO, NYSERDA and the Public Service Commission have all hired third party consultants to study the most efficient path to a zero carbon electric grid. A common conclusion from these studies is that significant amounts of dispatchable flexible generation will be required to backup intermittent renewable energy to ensure the reliability of the future electric grid. For instance, in June 2020 the Brattle Group issued a report entitled "New York's Evolution to a Zero Emission Power System"[16] which includes Figure 6-2 describing why balancing supply and load will be challenging.

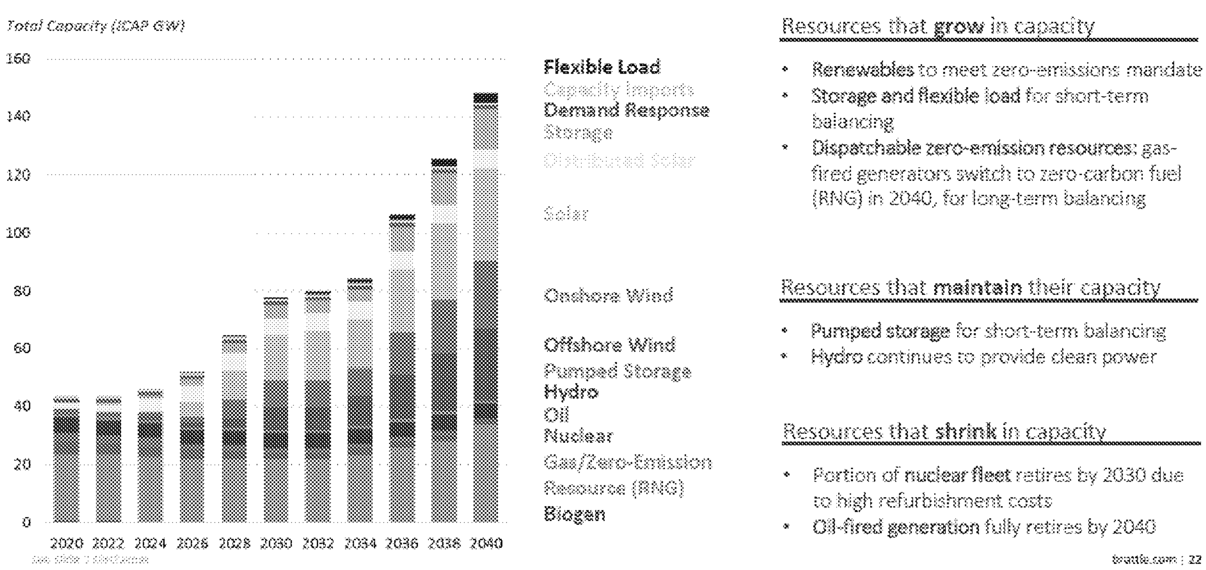
[16]https://www.nyiso.com/documents/20142/13245925/Brattle%20New%20York%20Electric%20Grid%20Evolution%20Study%20-%20June%202020.pdf/69397029-ffed-6fa9-cff8-c49240eb6f9d

Figure 6-2 Challenges Balancing Supply and Load



As indicated, battery storage and demand response can provide short-term balancing, but seasonal balancing is more difficult, cannot be met with battery storage and requires new technologies such as zero emission dispatchable generation. Next Brattle specifically looked at how New York's resource mix needs to change over the next 20 years. As depicted in Figure 6-3[17], gas fired generating resources not only remains an important component of New York's generating fleet over the next 20 years, but actually grow in size to provide long-term balancing services for intermittent renewables before switching to zero carbon fuel in 2040.

Figure 6-3 Evolution of New York's Generation Fleet



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[17] *Id.*

Similarly, the Analysis Group's September 2020 report entitled "Climate Change Impact Phase II" (Analysis Group, 2020) assesses power system reliability in 2040. Step one in that analysis was establishing the necessary resources to maintain a reliable electric system while meeting the requirements of the CLCPA.

As can be seen in Figure 6-4 (Table ES-1; Analysis Group, 2020), the report concludes New York will require over 32 GW of dispatchable zero emission resources in 2040 as compared to just over 23 GW of existing dispatchable gas fired resources today (NYISO 2020a). Which means even if every existing dispatchable gas-fired unit in the New York Control Area continued operating until 2040 and then switched over to a zero-carbon renewable fuel, the system would still need another 8,000 MW of dispatchable zero emission resources to remain reliable. These dispatchable resources are needed in addition to more than 15 GW of energy storage new build.

Figure 6-4 Generation Capacity and Storage

Table ES-1: Generation Capacity, CLCPA Resource Set

Nameplate Capacity by Zone, MW	A	B	C	D	E	F	G	H	I	J	K	Total
Land-based Wind	10,815.9	1,566.9	7,726.2	7,774.5	7,316.4	-	-	-	-	-	-	35,200.0
Offshore Wind	-	-	-	-	-	-	-	-	-	14,957.8	6,105.2	21,063.0
Solar (Behind-the-meter)	1,408.5	436.4	1,192.8	138.2	1,345.5	1,653.4	1,367.3	121.2	179.4	1,343.1	1,692.2	10,877.8
Solar (Grid Connected)	11,496.0	1,312.0	7,170.0	-	4,536.0	9,322.0	5,272.0	-	-	-	154.0	39,262.0
Hydro Pondage	2,675.0	-	-	856.0	-	-	41.6	-	-	-	-	3,572.6
Hydro Pumped Storage	-	-	-	-	-	1,170.0	-	-	-	-	-	1,170.0
Hydro Run-of-River	4.7	63.7	70.4	58.8	376.2	282.5	57.1	-	-	-	-	913.4
Nuclear	-	581.7	2,782.5	-	-	-	-	-	-	-	-	3,364.2
Imports	-	-	-	1,500.0	-	-	-	-	-	1,310.0	-	2,810.0
Storage	4,232.0	20.0	3,160.0	4,168.0	2,296.0	292.0	84.0	-	-	1,096.0	252.0	15,600.0
Price Responsive Demand (Summer)	949.9	205.2	510.1	357.7	211.1	433.9	246.3	58.6	134.9	1,940.8	187.6	5,236.0
Price Responsive Demand (Winter)	619.0	133.7	332.4	233.1	137.5	282.7	160.5	38.2	87.9	1,264.7	122.3	3,412.0
DE Resources	465.4	674.2	1,513.4	370.0	312.7	3,390.4	6,887.2	79.8	-	11,846.1	6,595.4	32,136.6

As an efficient quick start, fast ramping standby/backup generator that is expected to be able to convert to renewable fuel in the future, the Project is exactly the kind of resource these studies conclude is needed to safely, reliably, efficiently and economically support New York's transition to a zero carbon electric grid - fully consistent with the limits, targets and goals of the CLCPA.

D. Incorporates Energy Storage

The Replacement Project includes the proposed addition of an approximately 24 MWe BESS, which would ultimately replace the remaining P&W combustion turbines enabling black start capability for the site. The use of BESS to provide black start capability will result in GHG reductions from the shutdown of the aging, natural gas/ULSK fired P&W turbines in the amount of an additional 1,559 tons per year.

The Project will also preserve the Site, including its valuable Zone J electrical interconnections, for future additional stand-alone battery energy storage capacity[18].

[18] NRG has already initiated early development efforts for an onsite 79.9 MW stand alone battery storage system (Q830 in NYISO's electric interconnection queue). In addition, the Applicant notes it has sponsored a 1.5 MW mobile battery storage demonstration project in partnership with Con Edison on the Site as part of New York's Restoring the Energy Vision ("REV") initiative. The project, known as Storage on Demand, is currently under construction and expected to be operational by summer 2021.

Summary of Project's Consistency with the Limits, Targets, and Goals of the CLCPA

In summary, the Project is consistent with the limits, targets, and goals of the CLCPA and will play a key role in New York meeting the GHG reduction standards established by the CLCPA, ECL Article 75 and Part 496. These statements are based on the Project:

- Replacing 24 50-year-old operating P&W CTGs with a new, more efficient, state-of-the-art simple cycle dual-fuel CTG, resulting in annual reductions in direct and upstream GHG emissions from displacement of other less efficient electrical generating units;
- Facilitating further indirect GHG emission reductions due to its quick start and fast ramping capability, which allows additional renewable generation to be reliably interconnected to the New York bulk power system by providing needed electricity when intermittent resources are unavailable and/or when battery storage resources are insufficient;
- Minimizing the cost of reducing GHG emissions in New York City by supplying high value capacity in Zone J at less than 20 percent of the cost if marginal capacity were to be provided by battery storage systems alone, particularly during the 2030-2040 time period when the electrical system is rapidly transitioning to meet CLCPA targets;
- Incorporating energy storage technology at the site, with the attendant reduction in GHGs, through the proposed use of an approximately 24 MWe BESS for black start capability, which ultimately are proposed to replace two P&W combustion turbines currently using natural gas and fuel oil; and
- Preserving the site and its valuable electrical interconnections in Zone J for additional stand-alone energy storage applications in the future.

The Project is part of a cost-effective path for New York to meet the CLCPA and Part 496 GHG emission reduction requirements and the CLCPA's targets to increase renewable generation and achieve a zero GHG emission New York electrical system, while maintaining reliability. In the near-term, the Project will add an efficient, low-emitting resource to the New York electrical system, resulting in a reduction of direct GHG emissions and a reduction in upstream GHG emissions. In the mid to longer term (2030-2040), as other renewable resources are added to the system, maintaining efficient low capacity factor dual fuel generation in New York City is important to minimize system cost as technology develops to reach the ultimate CLCPA targets and to allow for renewables to be added to the system in a cost effective manner. The Project is best suited to fill this role and is forecasted to cause a combined direct, upstream and indirect reduction in GHG emissions through 2035[19] of over 5,000,000 tons (see Table 6-1 and Figure 6-1).The Project's 2030 and 2050 GHG emissions summarized in Table 6-2 are consistent with, and will not interfere with the attainment of, the CLCPA, ECL Article 75 and 6 NYCRR Part 496 GHG reduction requirements. In fact, the Project will assist the State in meeting the CLCPA emission reduction requirements. In 2030 alone, the Project will cause a direct reduction in Statewide Greenhouse Gas Emissions of 21,000 tons of CO_2e, 9,000 tons of CO_2e upstream, and an indirect reduction of 476,000 tons CO_2e due to the Project being able to facilitate additional renewables to come on-line. From 2023-2030 the total cumulative Statewide Greenhouse Gas Emission reductions from the Project are projected to be 998,000 tons, as follows: 362,000 tons (direct); 160,000 tons (upstream); and, 476,000 tons (indirect based on the renewable resources that the Project would allow to come onto the system). These reductions in Statewide Greenhouse Gas Emissions from the Project are consistent with the CLCPA, ECL Article 75 and Part 496 requirement that the State reduce Statewide Greenhouse Gas emissions by 40% from 1990 levels by 2030. In 2050, it is assumed that the Project combustion

[19] While the Navigant report only analyzed GHG emission reductions attributable to the Project through 2035, additional GHG emission reductions would continue through 2040.

turbine will either have transitioned to a zero-carbon fuel or will have shut down subject to the CLCPA provisions regarding safe and adequate electric service.[20]

The CLCPA and Section 66-p of the Public Service Law ("PSL") also require the PSC to establish a program that requires: an increase in renewables to 70% in 2030; and, the Statewide electricity demand system to meet a zero-emissions target in 2040. Although the program has not been fully developed by the PSC yet, the Project is consistent with the CLCPA and Section 66-p, since the Project will facilitate the addition of renewable generation to the electric system, and the combustion turbine will either transition to a zero carbon fuel, or stop operating by 2040 subject to the CLCPA provisions regarding safe and adequate electric service.

A summary of the Project's expected GHG emissions, and the emission reductions that the Project will cause, are included in Table 6-2.

Table 6-2 Project GHG Emissions in 2030 and 2050 (GWP20)

Type and Source of Emissions		2030 Emissions GHG/CO_2e	Cumulative 2023-2030 GHG/CO_2e	Cumulative 2023-2039 GHG/CO_2e	2050 Emissions GHG/CO_2e
Direct Emissions (tons)	Emissions from replacement generation that would be required without the Project	75,021	1,379,555	1,722,797	0
	Project Emissions	(-) 53,982	(-) 1,017,472	(-) 1,267,811	0
	Direct Emissions Reductions	**= 21,039**	**= 362,083**	**= 454,986**	Note (4)
Upstream Emissions (tons)	Emissions from replacement generation that would be required without the Project	33,872	628,484	786,275	0
	Project Emissions	(-) 24,840	(-) 468,268	(-) 583,437	0
	Upstream Emissions Reductions	**= 9,032**	**= 160,215**	**= 202,838**	Note (4)
Indirect Emissions (tons)	**Indirect Emissions Reductions** From the Project facilitating renewables being added to the system	**476,000**	**476,000**	**8,740,667**	Note (4)
	Total Emissions Reductions (tons) = Direct + Upstream + Indirect	**506,072**	**998,299**	**9,398,490**	Note (4)

(1) Basis for calculations provided in **Appendix I**.
(2) Based on Navigant/Guidehouse dispatch study, 2.5% estimated capacity factor 2030.
(3) Upstream emissions from the extraction, processing, and delivery of natural gas and ULSD.
(4) In 2040, it is assumed that the Project combustion turbine will either have transitioned to a zero-emission fuel or will have shut down subject to the CLCPA provisions regarding safe and adequate electric service. This is why cumulative emissions reductions are not shown through 2050.

[20] The PSC is required by CLCPA, and PSL 66-P(2) to establish a program that requires a zero-emission statewide electrical system by 2040, by June 30, 2021 unless PSC determines that the target needs to be modified based on considerations included in PSL Section 66-p . This program has not yet been established.

6.1.2 Assessment of the Project's GHG Emissions

A summary of the GHG emissions associated with the operation of the Project is provided below. A more detailed assessment and discussion of the Project's GHG emissions is included in the DSEIS, revised April 2021.

Table 6-3 presents the annual direct CO_2e emissions from the Project's combustion sources, including the CTG and ancillary combustion sources, under a likely operating scenario, based on the Navigant/Guidehouse dispatch analysis, as well as under the maximum operating assumptions contained in the Air Permit Application. Consistent with 6 NYCRR 496, the CO_2e emissions associated with the Project were calculated based on the 20-year GWP included in 6 NYCRR 496.5.

While there will be direct GHG emissions associated with the operation of the Project, the Project will reduce the overall direct GHG emissions from the electrical system by displacing less efficient electric generating units. (See Table 6-1, Table 6-2 and the Navigant/Guidehouse report included as Appendix F).

Table 6-3 Direct GHG Emissions – During Operation of the Project (tpy) (4)

Scenario(1)	GHG Component	CTG	Emergency Generator Engine(2)	Fire System Pump Engine #1(2)	Fire System Pump Engine #2(2)	Fugitives	Project Totals
Maximum Potential Permitted Emissions	CO_2	712,160	204	48	73	-	712,484
	CH_4	18.77	0.008	0.002	0.003	107.56	126.34
	N_2O	2.88	0.0017	0.0004	0.0006	-	2.88
	SF_6	-	-	-	-	0.00083	0.00083
	CO_2e (GWP20)	714,497	205	48	73	9,050	723,872
Expected Operations	CO_2	90,547	21	5	7	-	90,580
	CH_4	1.68	0.001	0.0002	0.0003	0(3)	1.68
	N_2O	0.17	0.00017	0.00004	0.00006	-	0.17
	SF_6	-	-	-	-	0(3)	-
	CO_2e (GWP20)	90,733(1)	21	5	7	0(3)	90,766(5)

(1) Based on Navigant/Guidehouse dispatch study, 4.4% expected annual average capacity factor for 2023-2035.

(2) Maximum permitted based on 500 hr/yr, expected based on 1-hr week normal operation for maintenance; or 52 hrs/yr operation.

(3) Equipment will not be designed or expected to leak.

(4) Basis for emission calculations provided in **Appendix I**.

(5) Fugitive emissions not included as equipment is not designed, or expected, to leak; if equipment fugitives conservatively included at the maximum potential emission rate, total CO_2e emissions would be 99,816 tpy (90,766 + 9,050).

Table 6-4 provides estimates of the upstream indirect GHG emissions associated with operation of the Project.

Table 6-4 Upstream Indirect GHG Emissions Associated with Operation of the Project

Scenario	GHG Emissions (tpy) (1)			
	CO_2	CH_4	N_2O	CO_2e (GWP20)
Maximum Permitted –Upstream	134,969	1,805	1.93	287,099
Expected – Upstream (2)	18,891	272	0.23	41,771

(1) Basis for upstream fuel emissions provided in Appendix F.
(2) Based on Navigant/Guidehouse dispatch study, 4.4% expected annual average capacity factor 2023-2035.

While there will be upstream indirect GHG emissions associated with the fuel used by the Project, the Project will actually reduce the overall amount of fuel used by the NYISO electric system by displacing less efficient electric generating units that need more fuel to produce the same amount of power (See Table 6-1). It will, therefore, reduce indirect upstream GHG emissions associated with the production and transportation of fuels to New York used to produce power, which further decreases GHGs from the electric system, and increases the GHG benefit of the Project.

The analysis conducted to estimate the reduction in upstream indirect GHG emissions associated with the Project's displacement of the older, less efficient units is summarized in Table 6-5.

Table 6-5 Reduction in Annual Upstream Indirect GHG Emissions Associated with the Project

Scenario	GHG Emissions (tpy) (1)			
	CO_2	CH_4	N_2O	CO_2e (GWP20)
Project Expected – Upstream(2)	18,891	272	0.227	41,771
Displaced Units – Upstream	25,356	365	0.305	56,069
Net Annual Benefit Expected from Project (2023-2035)	**-6,465**	**-93**	**-0.078**	**-14,298**

(1) Basis for emissions provided in **Appendix I.**
(2) Based on Navigant/Guidehouse dispatch study, 4.4% expected annual average capacity factor 2023-2035.

6.1.3 Avoidance, Mitigation and Minimization of GHGs by the Project

The Project will avoid and minimize GHG emissions by implementing BACT for GHGs. As discussed in more detail in this application, two control technologies for GHG emission reduction are proposed as BACT: (1) high-efficiency generating technology; and, (2) low-carbon fuels. It will also operate as a peaker facility such that it is expected to operate at a capacity factor of approximately 4.4% average annually over the 2023-2035 timeframe, with its operations limited pursuant to requested Title V permit emission limits equivalent to a capacity factor of approximately 30% annually. Due to the Project CTG's high efficiency and quick ramp-up rate, GHG emissions are further reduced.

The Project is proposing to replace the existing units with an H-class CTG, which provides the highest efficiency of any available comparably sized CTG. The Project will also be designed to maximize generation efficiency by minimizing sources of internal power consumption and maximizing net generation to the grid. The Project's CTG will have a heat rate of 9,544 Btu (HHV)/kW-hr (gross) at full-load ISO conditions for natural gas firing, and 9,850 Btu (HHV)/kW-hr (gross) at full-load ISO conditions for ULSD firing. Due to the high efficiency of the CTG, and as discussed further in Section 4.2.3, it will also displace other higher emitting generation units and their associated upstream emissions, thus having an overall reduction of GHGs from the electric grid (see Table 6-1 and Figure 6-1).

The Project will utilize natural gas as a fuel, with limited operation on ULSD when natural gas is unavailable. In order to ensure reliable service to the region, the Project is requesting emission limits that equate to operation up to the equivalent of approximately 1,900 hours per year on natural gas and limited operation on ULSD up to the equivalent of approximately 720 hours/year. The H-class CTG is also expected to be fully convertible to operate utilizing hydrogen created from renewable sources as fuel to generate zero-carbon electricity, if and when green hydrogen fuel is available in the future.[21]

Project modifications also will result in a smaller plant size (437 MWe vs 1,040 MWe) as compared to the Project as previously approved. Because the Project configuration is now proposed as a peaking facility, projected operations will represent a considerably smaller portion of the year, resulting in less GHG emissions.

As discussed in the Navigant/Guidehouse GHG Report and Supplement (**Appendix F**), the Project will cause an overall reduction in annual direct and upstream GHG emissions from the electrical system due to its efficiency and displacement of other higher emitting sources. The Project will also provide a capacity resource to the electrical system that allows more renewable generation to be added, while maintaining reliability in an efficient and cost-effective manner, resulting in further GHG emission reductions.

Nevertheless, as mitigation for direct GHG emissions at the Project location, Astoria will upgrade the starting system for the two P&W combustion turbines being retained for black start service. Presently, the twenty-four (24) existing P&W units use compressed natural gas to power their starting motors. Torsional force created by expanding compressed natural gas across a starting motor causes the turbine rotor to spin at sufficient speed to initiate fired operation of the units. After exiting the starting motor, the expanded natural gas is exhausted directly to the atmosphere. 0.53 tons of natural gas (methane) is required to start up each turbine, which results in 44.9 tons of CO_2e emissions per start.

The Project will include upgrading the starting system on each of the two retained P&W turbines to use compressed air instead of using compressed natural gas. This upgrade involves the installation of a new air compressor, receiver tank, turbine starting motor and associated piping and controls. Sufficient compressed air will be stored in the new receiver tank to start up each combustion turbine multiple times. Similar to the existing system, the compressed air will expand across the new starting motor to initiate operation of the turbines. The only direct emissions from the new starting system will be air instead of raw natural gas. As a result, each turbine start will result in a reduction of 44.9 tons of CO_2e emissions. Since both retained turbines are expected to start up at least once per month for testing in accordance with Con Edison's system restoration program requirements, the total GHG emissions savings will be 1,077 tons of CO_2e per year.

As discussed in Section 6.2, Future Physical Climate Risk is mitigated by designing the Project at a minimum elevation of 18.5 feet and is therefore consistent with the CRRA and 2018 guidance, to avoid, minimize and mitigate future physical climate risk.

[21] It should be noted the Project is not seeking to permit operation on hydrogen fuel at this time. Such operation will require a future amended permitting process.

6.1.4 Conclusion

The Replacement Project is consistent with, and will assist in the attainment of, both the CLCPA's renewable resource targets and the statewide GHG emission reductions. The Project is part of a cost-effective path for New York to meet the CLCPA's GHG emission reduction standards, and its targets to increase renewable generation and achieve a zero GHG emission New York electrical system, while maintaining reliability. In the near-term, the Project will add an efficient, low-emitting resource to the New York City electrical system, resulting in direct reduction of GHG emissions. In the mid to longer term (2030-2040), as other renewable resources are added to the system, maintaining efficient low capacity factor dual fuel generation in New York City is important to minimize system cost as technology develops to reach the ultimate CLCPA limits and to allow for renewables to be added to the system in a cost effective manner. The Project is best suited to fill this role and is forecasted to cause a combined direct and indirect reduction in GHG emissions through 2035 of almost 5,000,000 tons (as shown Figure 6-1).

6.2 Future Climate Risk Considered

Future physical climate risk includes sea-level rise, storm surge and flooding projected to occur based on the impacts of climate change. Analysis and mitigation of these risks is required by the CLCPA, as well as NYSDEC regulations and guidance. The impacts of future physical climate risk associated with the Project were considered, and mitigation measures are included in the Project design to reduce the potential impact of these risks on the Project now and into the future.

Section 17-B of the CLCPA requires applicants for specific permits, including Title V permits, to demonstrate that future physical climate risk has been considered. The 2014 Community Risk and Resiliency Act ("CRRA") also requires applicants for certain permits to demonstrate they have considered future physical climate risk due to sea-level rise, storm surge and flooding.

As part of the 2010 environmental review of the Project, an assessment of sea level rise was conducted. This assessment showed that at a grade elevation level of approximately 17 feet amsl, the Project site would be well protected from minor sea level fluctuations.

The Project's future physical climate risk was considered as it has been designed to be consistent with the relevant sea-level rise projections in Part 490 of Title 6 of the New York Code of Rules and Regulations and the 2018 Draft New York State Flood Risk Management Guidance for the Implementation of the Community Risk and Resiliency Act ("2018 Guidance"). The 2018 Guidance is used to determine suitable locations for construction of a proposed structure, given future physical climate risks associated with sea-level rise, storm surge and flooding. The 2018 Guidance provides recommended design elevations that take into account and mitigate these risks.

The high sea level rise projection included in Part 490.4(b) for 2050 and the additional freeboard per the 2018 Guidance were used to determine the elevation for the Project. The base flood elevation ("BFE") at the Project site is 13 feet (NAVD-88). The Project grade elevation was designed based on the 2018 Guidance, by adding the Part 490 sea-level rise projection for 2050 (2.5 feet) to the additional 3 feet of freeboard recommended in the 2018 Guidance. This resulted in a Project total elevation of 18.5 feet (13 feet + 2.5 feet + 3 feet). New Project structures will be constructed with a minimum grade elevation of 18.5 feet amsl.

Based on the minimum planned grade elevation of new Project equipment at 18.5 feet amsl, the Project will be protected from future physical climate risks.

6.3 Disadvantaged Communities

The CLCPA also seeks to ensure that disadvantaged communities are not disproportionately burdened. One of the components of the CLCPA, therefore, is the identification of disadvantaged communities. Section 75-0101 defines disadvantaged communities as "communities that bear burdens of negative public health effects, environmental pollution, impacts of climate change, and possess certain socioeconomic criteria, or comprise high-concentrations of low- and moderate- income households, as identified pursuant to section 75-0111 of this article." Although this identification process is ongoing, using New York's interim criteria for disadvantaged communities, a comparison was made between CLCPA interim disadvantaged communities and the updated PEJA. Given the general agreement in the areas covered by each program, the EJ analysis fulfills the disadvantaged communities' component of the CLCPA and establishes that the Project will not disproportionately burden disadvantaged communities.

The CLCPA directs New York State's Climate Justice Working Group ("CJWG") to establish criteria for defining disadvantaged communities. While this process is ongoing, until new criteria are established, New York State has identified interim criteria for disadvantaged communities[22], which includes communities:

- Located within census block groups that meet the Housing and Urban Development ("HUD") 50% Area Median Income ("AMI") threshold[23], that are also located within the DEC PEJAs; and,
- Located within New York State Opportunity Zones[24].

The following census block groups located in Queens County within one mile of the Project site meet the interim criteria for disadvantaged communities: 103-4, 113-1, 113-2, 113-3, and 105-1. Figure 6-5 shows the CLCPA interim disadvantaged communities located within the one-mile study area (i.e., those areas meeting one or both of the criteria listed above).

A comparison of the CLCPA interim disadvantaged communities shown in Figure 6-5 with the updated PEJA shown in Figure 6-6 shows general agreement in the areas covered by each program. As such, the Applicant's EJ analysis fulfills the disadvantaged communities' component of the CLCPA. The EJ analysis is included in Section 3.3 and establishes that the Project will not disproportionately burden disadvantaged communities.

[22] As listed on NYSERDA's website https://www.nyserda.ny.gov/ny/disadvantaged-communities.

[23] Top quartile of census block groups in New York, ranked by the percentage of LMI Households in each census block. LMI Households are defined as households with annual incomes at or below 50% of the Area Median Income of the County or Metro area where the Census Block Group resides.

[24] A low-income census tract with an individual poverty rate of at least 20% and median family income no greater than 80% of the area median. New York State is participating in the new Opportunity Zone community development program, offered through the Tax Cuts and Job Acts of 2017. The federal program encourages private investment in low-income urban and rural communities. Based on analyses by Empire State Development ("ESD"), New York State Homes and Community Renewal ("HCR"), New York State Department of State ("DOS") and the state's Regional Economic Development Councils ("REDC"s), New York State has recommended 514 census tracts to the U.S. Department of the Treasury for designation as Opportunity Zones.

Figure 6-5 CLCPA Disadvantaged Areas Located within One Mile Study Area

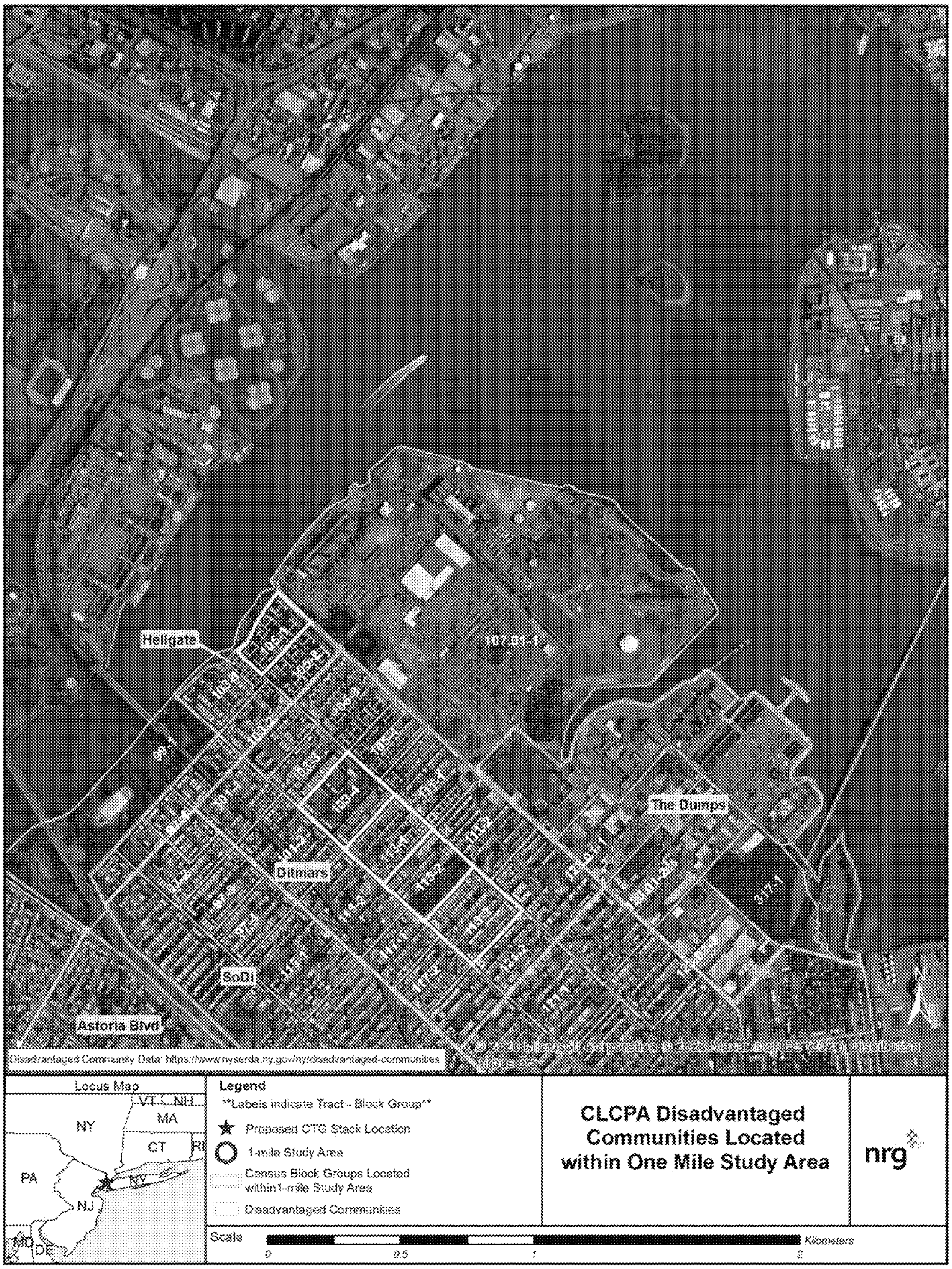

Figure 6-6 Updated Potential Environmental Justice Area

ED_013256A_00001460-00103

6.3.1 Environmental Justice Overview

The first step in in conducting an EJ analysis is to "identify potential adverse environmental impacts and the areas to be affected." The next step is to "determine whether potential adverse environmental impacts are likely to affect a potential environmental justice area." A "potential environmental justice area" ("PEJA") is defined as a minority and/or low-income community that may bear a disproportionate share of the negative environmental consequences resulting from industrial operations or the execution of programs and policies.

The NYSDEC has defined thresholds for low-income and minority communities as follows:

- *Low-income community* means a census block group, or contiguous area with multiple census block groups, having a low-income population equal to or greater than 23.59% of the total population for rural and urban areas.
- *Minority community* means a census block group, or contiguous area with multiple census block groups, having a minority population equal to or greater than 51.1% in an urban area and 33.8% in a rural area of the total population.

Low income population, minority population, urban area, and rural area are defined in CP-29 as follows:

- *Minority population* means "a population that is identified or recognized by the U.S. Census Bureau as Hispanic, African-American or Black, Asian and Pacific Islander or American Indian."
- *Low income population* means "a population having an annual income that is less than the poverty threshold. For purposes of this policy, poverty thresholds are established by the U.S. Census Bureau."
- *Urban Area* means "all territory, population, and housing units located in urbanized areas and in places of 2,500 or more inhabitants outside of an urbanized area. An urbanized area is continuously built-up area with a population of 50,000 or more. For purposes of this policy, urban classifications are established by the U.S. Census Bureau."
- *Rural Area* means "territory, population, and housing units that are not classified as an urban area."

For the year 2010, the area surrounding the Facility is considered to be urban for the purpose of selecting the appropriate minority thresholds based on U.S. Census Bureau data[25].

Where a PEJA is identified by the preliminary screen, the applicant is required to submit a written enhanced public participation plan ("EPPP") as part of its complete application. In accordance with Section V.D of CP-29, the plan must demonstrate that the applicant will:

1. Identify stakeholders to the proposed project;
2. Distribute and post written information on the proposed project and permit review process;
3. Hold public information meetings to keep the public informed about the proposed project and permit review status; and
4. Establish easily accessible document repositories in or near the potential EJ area to make available pertinent project information.

Once all of the components of the plan have been completed, the applicant is required to submit documentation certifying that it has complied with the plan. As part of the certification, the applicant is

[25] http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml

required to submit a revised report detailing activity that occurred subsequent to the initial submission of the report.

6.3.2 Preliminary Environmental Justice Screen

The NYSDEC's EJ website (http://www.dec.ny.gov/public/911.html) contains a link to a Geospatial Information System ("GIS") data layer of PEJAs that can be downloaded from NYSDEC's Google Maps and Earth. A map of the area in the vicinity of the Astoria Facility shows that there are several PEJAs within one mile of the Facility based on 2000 census data (see Figure 6-6)[26]. This finding is based on the census data showing that several census block groups have minority and/or low income populations above the NYSDEC EJ thresholds. A review of the 2010 census data confirms the presence of PEJAs within one mile of the Facility, although the extent of the PEJAs located in Queens is considerably less than the extent based on the 2000 census data.

6.3.3 Summary of Prior EJ Analysis Conducted for the Project

A comprehensive EJ analysis was previously conducted for the Project and was documented in the 2009 DEIS. That analysis confirmed the location of several PEJAs within the one-mile study area based on the 2000 census data. As such, and in accordance with CP-29, Astoria conducted the following analyses to determine whether potential disproportionate adverse environmental impacts were likely to affect a PEJA:

- an evaluation of the existing environmental burden on the PEJAs;
- an evaluation of the potential additional burden of any disproportionate adverse impacts directly related to the Project; and
- an evaluation of the health-related community conditions in accordance with New York State Department of Health, Guidance for Health Outcome Data Review and Analysis Relating to NYSDEC Environmental Justice and Permitting, Draft 7/21/08 ("HOD" Guidance).

A review of the 2000 U.S. Census Data showed that the PEJAs located within the study area and the Astoria community are interspersed with census tracts and block groups that are not minority or economically disadvantaged populations. The 2009 analysis found that the overall portion of the population of Astoria within the study area fell well outside of the characteristics of EJ review criteria (poverty and minority) and were subject to the same net environmental burden as are the persons living within the defined EJ areas.

This prior environmental impact analysis demonstrated that the Project would not result in any disproportionate adverse impacts to any PEJA based on an evaluation of the following:

- air quality;
- water quality;
- noise;
- visual character and shadows;
- historic resources;
- natural resources;
- land use, zoning, neighborhood character, and open space;
- socioeconomics;

[26] The 2009 EJ analysis used a one-mile radius study area as agreed to by the NYSDEC and the New York State Department of Health ("NYSDOH") as part of the SEQRA scoping process.

- waterfront revitalization;
- transportation;
- infrastructure and solid waste;
- energy; and
- construction.

The HOD analysis demonstrated that the Astoria population residing within Zip Code 11105 (which includes the portion of the one-mile radius study area located in Queens) does not reflect an unusual health outcome profile and is, in fact, generally healthier with respect to asthma and cancers than the selected zip code comparison areas as well as in comparison to all of Queens County and all of New York City.

Based on the evaluations described above, NYSDEC concluded that the Project would not contribute any additional environmental burden on the nearby PEJA. (FEIS[27], Section 11.0).

Astoria also previously prepared and implemented an EPPP in order to inform the interested public with regard to the Project. The EPPP was originally submitted to the NYSDEC on February 23, 2009 and was approved by the NYSDEC on February 27, 2009. Astoria submitted an updated EPPP on February 15, 2010, which included the required certification. Thereafter, NYSDEC determined that Astoria's public outreach was consistent with CP-29. (FEIS, Section 4.10.5).

6.3.4 Summary of Updated EJ Analysis and Demonstration of No Adverse Impact

Astoria's prior environmental justice analysis was updated and supplemented as part of Astoria's supplemental environmental review of the Project under SEQRA. An updated EJ analysis, including an evaluation of NYSDOH Health Outcome Data and a multi-media environmental burden analysis, is included in the DSEIS, revised April 2021. In addition, Astoria updated and supplemented the 2010 EPPP for the Project, and is implementing the 2020 Supplemental EPPP.

Air quality dispersion modeling was conducted to estimate the ambient air quality impact from Project emissions and to determine the locations of the highest impacts. The results of this analysis documented in Section 5 show that maximum predicted concentrations from the Project are well below the health- and welfare-based NAAQS and below the SILs for all criteria pollutants. The modeling analysis also showed that the maximum 1-hour and annual average concentrations for air toxic compounds are well below the NYSDEC's SGCs and AGCs. The maximum modeled concentrations for all averaging periods are predicted to occur within 1000 meters (0.6 miles) of the proposed stack. Based on these modeling results, it can be concluded that, as concluded in 2010, the Project would not result in an adverse air quality impact at any location, including any low income and/or minority area.

As discussed in more detail in the DSEIS, implementation of the Project as currently configured will not cause adverse or disproportionate impacts in the PJEA. Because the Project will replace the existing turbines at the Astoria Gas Turbine Power facility, there is no additional burden on the community. The new CTG will be equipped with state-of-the-art emissions controls and have a GEP stack built to 250 feet to improve air dispersion and reduce impacts, as opposed to the 40-foot stacks on each of the existing turbines. Furthermore, the Project will provide significant economic benefits to the community during construction and operation. This conclusion is consistent with the findings of the 2010 EJ analysis.

[27] Astoria Repowering Project, Final Environmental Impact Statement ("FEIS"), Air Resources Group, LLC, submitted to NYSDEC September 22, 2010.

7.0 References

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Appendix A

NYSDEC Title V Permit Application Forms

New York State Department of Environmental Conservation
Air Permit Application

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

DEC ID	APPLICATION ID	Application Type
2-6301-00191	2-6301-00191/00003	☐ State Facility ☒ **Title V**

Section I - Certification

Certification			
I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons directly responsible for gathering the information required to complete this application, I believe the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations.			
Responsible Official	**Andrew Scano**	Title	**Plant Manager**
Signature	Andrew Scano	Date	**4 / 23 / 2020**

Professional Engineer Certification			
I certify under penalty of law that I have personally examined, and am familiar with, the statements and information submitted in this document and all its attachments as they pertain to the practice of engineering. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations			
Professional Engineer	**Yan Zhang**	NYS License No.	**092179**
Signature	Yan Zhang	Date	**4 / 23 / 2020**

Section II - Identification Information

Type of Permit Action Required	
☐New ☐Renewal ☒**Significant Modification** ☐Administrative Amendment ☐Minor Modification	
☐Application involves construction of new facility	☒**Application involves construction of new emission unit(s)**

Facility Information			
Name	**Astoria Gas Turbine Power LLC**		
Location Address	**31-01 20th Avenue**		
☐City / ☐ Town / ☐ Village	**Astoria**	Zip	**11105**

Owner/Firm Information						Business Taxpayer ID
Name	**Astoria Gas Turbine Power LLC**					**411937470**
Street Address	**4401 Victory Boulevard**					
City	**Staten Island**	State/Province	**NY**	Country	**USA**	Zip **10314**
Owner Classification	☐ Federal	☐ State	☐ Municipal	☒ **Corporation/Partnership**	☐ Individual	

Owner/Firm Contact Information					
Name	**Andrew Scano**			Phone **718-274-8843**	
E-mail Address	**Andrew.Scano@nrg.com**			Fax	
Affiliation	**Astoria Gas Turbine Power LLC**			Title **Plant Manager**	
Street Address	**31-01 20th Avenue**				
City	**Astoria**	State/Province	**NY**	Country **USA**	Zip **11105**

Facility Contact Mailing Address					
Name	**Elizabeth Vaccaro**			Phone No. **718-489-0022**	
E-mail Address	**Elizabeth.Vaccaro@nrg.com**			Fax	
Affiliation	**Astoria Gas Turbine Power LLC**			Title **EHS Specialist**	
Street Address	**31-01 20th Avenue**				
City	**Astoria**	State/Province	**NY**	Country **USA**	Zip **11105**

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Project Description ☒Continuation Sheet(s)

Section III - Facility Information

Facility Classification					
☐Hospital	☐Residential	☐Educational/Institutional	☐ Commercial	☐ Industrial	☒ **Utility**

Affected States (Title V Applications Only)				
☐ Vermont	☐ Massachusetts	☐ Rhode Island	☐ Pennsylvania	Tribal Land: ____________
☐ New Hampshire	☒ **Connecticut**	☒ **New Jersey**	☐ Ohio	Tribal Land: ____________

SIC Code(s)			NAICS Code(s)			
4911			**221112**			

Facility Description ☒ Continuation Sheet(s)

Compliance Statements (Title V Applications Only)

I certify that as of the date of this application the facility is in compliance with all applicable requirements: ☒ **YES** ☐ NO

If one or more emission units at the facility are not in compliance with all applicable requirements at the time of signing this application (the 'NO' box must be checked), the noncomplying units must be identified in the "Compliance Plan" block on page 8 of this form along with the compliance plan information required. For all emission units at this facility that are operating <u>in compliance</u> with all applicable requirements complete the following:

- ☒ This facility will continue to be operated and maintained in such a manner as to assure compliance for the duration of the permit, except those units referenced in the compliance plan portion of this application.
- ☒ For all emission units, subject to any applicable requirements that will become effective during the term of the permit, this facility will meet all such requirements on a timely basis.
- ☒ Compliance certification reports will be submitted at least once a year. Each report will certify compliance status with respect to each applicable requirement, and the method used to determine the status.

Facility Applicable Federal Requirements ☒ Continuation Sheet(s)

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	**NYCRR**	**225**	**1**	**2**	**h**				
40	**CFR**	**97**	**AAAAA**	**406**					
40	**CFR**	**97**	**CCCCC**	**606**					
40	**CFR**	**97**	**EEEEE**	**806**					

Facility State Only Requirements ☐Continuation Sheet(s)

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	**NYCRR**	**201**	**1**	**4**					
6	**NYCRR**	**242**	**1**	**5**					
6	**NYCRR**	**242**	**4**						
6	**NYCRR**	**242**	**8**						
6	**NYCRR**	**242**	**8**	**5**					

DEC ID												
2	-	6	3	0	1	-	0	0	1	9	1	

Section II - Identification Information

Project Description (continuation)

The Replacement Project will replace existing operating gas and oil-fired turbines at the Astoria Facility with a new state-of-the-art simple cycle combustion turbine unit. The Replacement Project addresses a 220 MWe reliability shortfall identified by the New York Independent System Operator and Con Edison in the Astoria East Transmission Load Area. The Project will be located at the Astoria Facility on a portion of the land currently occupied by the existing retired Westinghouse turbines.

The primary air emission source associated with the Project is the CTG rated at approximately 437 MWe operating in simple-cycle mode to provide electric power during periods of peak demand. The CTG generating system will primarily include: one GE H-Class 7HA.03 combustion turbine; an evaporative inlet air cooler; tempering air fans; SCR system, complete with an ammonia (NH_3) injection skid; oxidation catalyst; exhaust stack; a three-winding main generator step-up transformer; auxiliary transformer; and electrical switchgear.

The Project will also include ancillary emission sources including one 500 electrical kilowatt (kWe) ULSD-fired emergency generator with a 500 mechanical kilowatt (kWm) engine and two ULSD-fired emergency fire system pump engines; 117 and 177 kWm, respectively.

The existing twelve P&W Twin Pac units (consisting of 24 total turbines) will continue to operate until the H-Class turbine commences operation after the Project's initial shakedown period, after which 22 of these turbines will be permanently shut down. One existing P&W Twin Pac unit consisting of two turbines (Emission Sources GT24A and GT24B) will temporarily remain operational to maintain black-start capability for the site until replaced by a battery energy storage system. As existing emission units, the 2 remaining P&W turbines are not considered part of the Replacement Project,

Facility Description (continuation)

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Facility Applicable Federal Requirements (continuation)									
Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
40	CFR	60	A	7	a				
40	CFR	60	A	7	c				
40	CFR	60	A	7	f				
40	CFR	60	A	7	g				
40	CFR	60	A	8	a				
40	CFR	60	A	8	d				
40	CFR	60	A	13					
40	CFR	68							
40	CFR	72							
40	CFR	82	F						
6	NYCRR	200		6					
6	NYCRR	201	6	4	a	7			
6	NYCRR	201	6	4	c				
6	NYCRR	201	6	4	c	2			
6	NYCRR	201	6	4	c	3	ii		
6	NYCRR	201	6	4	e				
6	NYCRR	202	2	1					
6	NYCRR	202	2	5					
6	NYCRR	215		2					
6	NYCRR	200		7					
6	NYCRR	201	1	7					
6	NYCRR	201	1	8					
6	NYCRR	201	3	2	a				
6	NYCRR	201	3	3	a				
6	NYCRR	201	6	4	a	4			
6	NYCRR	201	6	4	a	8			
6	NYCRR	201	6	4	f	6			
6	NYCRR	202	1	1					
6	NYCRR	201	6	4	d	4			
6	NYCRR	211		2					
6	NYCRR	227	1	3					
6	NYCRR	227	3						

Facility Applicable State Only Requirements (continuation)									
Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	NYCRR	211		1					

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Facility Compliance Certification									☒Continuation Sheet(s)
Rule Citation									
Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	NYCRR	227	2	5	b				
☒ Applicable Federal Requirement ☐ State Only Requirement	☒ Capping	CAS Number		Contaminant Name					
		0NY210 - 00 - 0		Oxides of Nitrogen					

Monitoring Information

☐ Work Practice Involving Specific Operations ☐ Ambient Air Monitoring ☒**Record Keeping/Maintenance Procedures**

Compliance Activity Description

NRG Energy Inc.'s system-wide averaging of the most recent NOx emissions from its facilities in New York State (including the Astoria Gas Turbine Power facility) must be performed in accordance with NOx RACT System-wide Compliance Plan submitted by NRG Energy, Inc and approved by the Department. Records will be kept in accordance with the Plan and compliance will be demonstrated on a 24-hour basis during the Ozone season and on a 30 day rolling average for the rest of the year.

Work Practice Type	Process Material Code	Process Material Description	Reference Test Method

Parameter Code	Parameter Description	Manufacturer Name/Model No.

Limit Upper	Limit Lower	Limit Units Code	Limit Units Description

Averaging Method Code	Averaging Method Description	Monitoring Frequency Code	Monitoring Frequency Description	Reporting Requirements Code	Reporting Requirements Description

Facility Emissions Summary ☐ Continuation Sheet(s)

CAS Number	Contaminant Name	Potential to Emit (tons/yr)	Actual Emissions (lbs/yr)
0NY075 - 00 - 5	PM-10	**52.6**	
0NY075 - 02 - 5	PM-2.5	**52.6**	
007446 - 09 - 5	Sulfur Dioxide	**7.9**	
0NY210 - 00 - 0	Oxides of Nitrogen	**100.4**	
000630 - 08 - 0	Carbon Monoxide	**92.2**	
007439 - 92 - 1	Lead (elemental)	**0.02**	
0NY998 - 10 - 0	Total Volatile Organic Compounds	**25.4**	
0NY100 - 00 - 0	Total Hazardous Air Pollutants	**4.6**	
0NY750 - 00 - 0	Carbon Dioxide Equivalents	**717,002**	
- -			
- -			
- -			
- -			

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Facility Compliance Certification (continuation)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	NYCRR	207							

		CAS Number	Contaminant Name
☒ **Applicable Federal Requirement** ☐ State Only Requirement	☐ Capping	- -	

Monitoring Information

☐ Continuous Emission Monitoring
☐ Intermittent Emission Testing
☐ Ambient Air Monitoring
☐ Monitoring of Process or Control Device Parameters as a Surrogate
☐ Work Practice Involving Specific Operations
☒ **Record Keeping/Maintenance Procedures**

Description

Astoria Gas Turbine Power LLC (Astoria) must implement the actions set forth in their Episode Action Plan, dated May 6, 2002, when the Commissioner determines that an air pollution episode exists and must indicate the actions taken at the facility to the Region 2, Regional Air Pollution Control Engineer of the Department, via phone call, within one day of the episode, and by submitting a written report on the actions taken at the facility within 5 days of the episode.

Work Practice	Process Material		Reference Test Method
Type	Code	Description	

Parameter		Manufacturer Name/Model No.
Code	Description	

Limit		Limit Units	
Upper	Lower	Code	Description

Averaging Method		Monitoring Frequency		Reporting Requirements	
Code	Description	Code	Description	Code	Description

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Section III - Facility Information

Facility Compliance Certification (continuation)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	NYCRR	201	6						

		CAS Number	Contaminant Name
☒ Applicable Federal Requirement ☐ State Only Requirement	☐ Capping	0NY998 - 10 - 0	Volatile organic compounds

Monitoring Information

☐ Continuous Emission Monitoring
☐ Intermittent Emission Testing
☐ Ambient Air Monitoring
☐ Monitoring of Process or Control Device Parameters as a Surrogate
☐ Work Practice Involving Specific Operations
☒ **Record Keeping/Maintenance Procedures**

Description

The facility is proposing to limit emissions of volatile organic compounds (VOC) below the significant net emissions increase threshold of 25 TPY. The VOC ERC emissions have been calculated to be 0.72 TPY from the shutdown of 22 Pratt & Whitney combustion turbines and curtailment of 2 Pratt & Whitney combustion turbines at the site. The proposed net emissions increase for the project is 24.90 TPY which will use 0.50 TPY of ERCs and create 0.22 TPY ERCs for future use. By accepting a limit of 25.41 TPY of VOC, the facility will net out of Part 231 NNSR requirements.

The permittee shall maintain records to demonstrate compliance with the VOC emission limit of 25.41 tons on a rolling twelve-month basis. This limit will establish does not exceed the nonattainment new source review major modification threshold of 25 tons per year.

Work Practice Type	Process Material Code	Process Material Description	Reference Test Method

Parameter Code	Parameter Description	Manufacturer Name/Model No.

Limit Upper	Limit Lower	Limit Units Code	Limit Units Description
25.41		38	Tons per year

Averaging Method Code	Averaging Method Description	Monitoring Frequency Code	Monitoring Frequency Description	Reporting Requirements Code	Reporting Requirements Description
17	Annual max, rolled monthly	05	Monthly	14	Semi-Annual (Calendar)

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Facility Compliance Certification (continuation)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	NYCRR	201	6						

Requirement	Capping	CAS Number	Contaminant Name
☒ Applicable Federal Requirement ☐ State Only Requirement	☐ Capping	0NY210 - 00 - 0	Oxides of Nitrogen

Monitoring Information

- ☐ Continuous Emission Monitoring
- ☐ Intermittent Emission Testing
- ☐ Ambient Air Monitoring
- ☐ Monitoring of Process or Control Device Parameters as a Surrogate
- ☐ Work Practice Involving Specific Operations
- ☒ **Record Keeping/Maintenance Procedures**

Description

The facility is proposing to limit emissions of oxides of nitrogen (NOx) below the significant net emissions increase threshold of 25 TPY. The NOx ERC emissions have been calculated to be 126.04 TPY from the shutdown of 22 Pratt & Whitney combustion turbines and curtailment of 2 Pratt & Whitney combustion turbines at the site. The proposed net emissions increase for the project is 24.90 TPY which will use 72.55 TPY of ERCs and create 53.49 TPY ERCs for future use. By accepting a limit of 100.44 TPY of NOx, the facility will net out of Part 231 NNSR requirements.

The permittee shall maintain records to demonstrate compliance with the NOx emission limit of 100.44 tons on a rolling twelve-month basis. This limit will establish does not exceed the nonattainment new source review major modification threshold of 25 tons per year.

Work Practice Type	Process Material Code	Process Material Description	Reference Test Method

Parameter Code	Parameter Description	Manufacturer Name/Model No.

Limit Upper	Limit Lower	Limit Units Code	Limit Units Description
100.44		38	Tons per year

Averaging Method Code	Averaging Method Description	Monitoring Frequency Code	Monitoring Frequency Description	Reporting Requirements Code	Reporting Requirements Description
17	Annual max, rolled monthly	05	Monthly	14	Semi-Annual (Calendar)

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Facility Compliance Certification (continuation)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	NYCRR	231	8	6	a				

		CAS Number	Contaminant Name
☒ Applicable Federal Requirement ☐ State Only Requirement	☐ Capping	0NY075 - 00 - 5	PM-10

Monitoring Information

☐ Continuous Emission Monitoring
☐ Intermittent Emission Testing
☐ Ambient Air Monitoring
☐ Monitoring of Process or Control Device Parameters as a Surrogate
☐ Work Practice Involving Specific Operations
☒ **Record Keeping/Maintenance Procedures**

Description

The facility shall limit emissions of PM-10 to 52.63 tons per year on a 12-month rolling basis.

The permittee shall maintain records to demonstrate compliance with the PM-10 emission limit of 52.63 tons on a rolling twelve-month basis. A summary of emissions shall be submitted to the department with the semi-annual monitoring report.

Work Practice Type	Process Material Code	Process Material Description	Reference Test Method

Parameter Code	Parameter Description	Manufacturer Name/Model No.

Limit Upper	Limit Lower	Limit Units Code	Limit Units Description
52.63		38	Tons per year

Averaging Method Code	Averaging Method Description	Monitoring Frequency Code	Monitoring Frequency Description	Reporting Requirements Code	Reporting Requirements Description
17	Annual max, rolled monthly	05	Monthly	14	Semi-Annual (Calendar)

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Facility Compliance Certification (continuation)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	NYCRR	231	8	6	a				

		CAS Number	Contaminant Name
☒ Applicable Federal Requirement ☐ State Only Requirement	☐ Capping	0NY075 - 02 - 5	PM-2.5

Monitoring Information

☐ Continuous Emission Monitoring
☐ Intermittent Emission Testing
☐ Ambient Air Monitoring
☐ Monitoring of Process or Control Device Parameters as a Surrogate
☐ Work Practice Involving Specific Operations
☒ **Record Keeping/Maintenance Procedures**

Description

The facility shall limit emissions of PM-2.5 to 52.63 tons per year on a 12-month rolling basis.

The permittee shall maintain records to demonstrate compliance with the PM-2.5 emission limit of 52.63 tons on a rolling twelve-month basis. A summary of emissions shall be submitted to the department with the semi-annual monitoring report.

Work Practice Type	Process Material Code	Process Material Description	Reference Test Method

Parameter Code	Parameter Description	Manufacturer Name/Model No.

Limit Upper	Limit Lower	Limit Units Code	Limit Units Description
52.63		38	Tons per year

Averaging Method Code	Averaging Method Description	Monitoring Frequency Code	Monitoring Frequency Description	Reporting Requirements Code	Reporting Requirements Description
17	Annual max, rolled monthly	05	Monthly	14	Semi-Annual (Calendar)

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Facility Compliance Certification (continuation)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	NYCRR	231	8	6	a				

☒ Applicable Federal Requirement ☐ State Only Requirement	☐ Capping	CAS Number	Contaminant Name
		0NY750 - 00 - 0	Carbon Dioxide Equivalents

Monitoring Information

☐ Continuous Emission Monitoring
☐ Intermittent Emission Testing
☐ Ambient Air Monitoring
☐ Monitoring of Process or Control Device Parameters as a Surrogate
☐ Work Practice Involving Specific Operations
☒ **Record Keeping/Maintenance Procedures**

Description

The facility shall limit emissions of carbon dioxide equivalents to 717,002 tons per year on a 12-month rolling basis.

The permittee shall maintain records to demonstrate compliance with the CO2e emission limit of 717,002 tons on a rolling twelve-month basis. A summary of emissions shall be submitted to the department with the semi-annual monitoring report.

Work Practice Type	Process Material Code	Process Material Description	Reference Test Method

Parameter Code	Parameter Description	Manufacturer Name/Model No.

Limit Upper	Limit Lower	Limit Units Code	Limit Units Description
717,002		38	Tons per year

Averaging Method Code	Averaging Method Description	Monitoring Frequency Code	Monitoring Frequency Description	Reporting Requirements Code	Reporting Requirements Description
17	Annual max, rolled monthly	05	Monthly	14	Semi-Annual (Calendar)

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Section III - Facility Information

Facility Compliance Certification (continuation)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	NYCRR	231	11	2	c				

		CAS Number	Contaminant Name
☒ Applicable Federal Requirement ☐ State Only Requirement	☐ Capping	- -	

Monitoring Information

☐ Continuous Emission Monitoring
☐ Intermittent Emission Testing
☐ Ambient Air Monitoring
☐ Monitoring of Process or Control Device Parameters as a Surrogate
☐ Work Practice Involving Specific Operations
☒ **Record Keeping/Maintenance Procedures**

Description

Emissions of carbon monoxide (CO) and sulfuric acid mist (H2SO4) from installation of Emission Units CTG01 and ENGES are projected to result in a net emissions increase greater than 50% of the significant net emissions threshold for each pollutant. The permittee shall track annual emissions of each pollutant in accordance with Part 231-11.2(c).

A report of emissions consisting of the information in Part 231-11.2(c)(3) shall be submitted to the Department within 30 days of the end of the calendar year.

Work Practice Type	Process Material Code	Process Material Description	Reference Test Method

Parameter Code	Parameter Description	Manufacturer Name/Model No.

Limit Upper	Limit Lower	Limit Units Code	Limit Units Description

Averaging Method Code	Averaging Method Description	Monitoring Frequency Code	Monitoring Frequency Description	Reporting Requirements Code	Reporting Requirements Description
63	See monitoring description	14	See monitoring description	15	Annual (Calendar)

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Section III - Facility Information

Facility Compliance Certification (continuation)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	NYCRR	201	6						

		CAS Number	Contaminant Name
☐ Applicable Federal Requirement ☒ **State Only Requirement**	☐ Capping	- -	

Monitoring Information

☐ Continuous Emission Monitoring
☐ Intermittent Emission Testing
☐ Ambient Air Monitoring
☐ Monitoring of Process or Control Device Parameters as a Surrogate
☐ Work Practice Involving Specific Operations
☒ **Record Keeping/Maintenance Procedures**

Description

The permittee shall cease operation of Sources GT21A, GT21B, GT22A, GT22B, GT23A, GT23B, GT24A, GT24B, GT31A, GT31B, GT32A, GT32B, GT33A, GT33B, GT34A, GT34B, GT42A, GT42B, GT43A, GT43B, GT44A, GT44B after the Replacement Project's shakedown period.

The facility will notify the Department within 30 days of the shutdown and permanent removal of the simple cycle combustion turbines.

Work Practice Type	Process Material Code	Process Material Description	Reference Test Method

Parameter Code	Parameter Description	Manufacturer Name/Model No.

Limit Upper	Limit Lower	Limit Units Code	Limit Units Description

Averaging Method Code	Averaging Method Description	Monitoring Frequency Code	Monitoring Frequency Description	Reporting Requirements Code	Reporting Requirements Description
		14	As required, see description	16	As required, see description

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Section IV - Emission Unit Information

Emission Unit Description

☒ Continuation Sheet(s)

Emission Unit: U-CTG01

General Electric H-Class, model 7HA.03 simple cycle combustion turbine. Can operate on either natural gas or ultra low sulfur distillate (ULSD) fuel.

Building Information

☐ Continuation Sheet(s)

Building ID	Building Name	Length (ft)	Width (ft)	Orientation
CTG INLET	Turbine generator inlet filter house	40	60	130
FP BLDG	Fire Pump Building	45	17	40

Emission Unit Emissions Summary

Emission Unit: -

☐ Continuation Sheet(s)

CAS Number	Contaminant Name			
- -				
ERP (lbs/yr)	PTE Emissions (lbs/hr)	PTE Emissions (lbs/yr)	Actual Emissions (lbs/hr)	Actual Emissions (lbs/yr)
CAS Number	**Contaminant Name**			
- -				
ERP (lbs/yr)	PTE Emissions (lbs/hr)	PTE Emissions (lbs/yr)	Actual Emissions (lbs/hr)	Actual Emissions (lbs/yr)
CAS Number	**Contaminant Name**			
- -				
ERP (lbs/yr)	PTE Emissions (lbs/hr)	PTE Emissions (lbs/yr)	Actual Emissions (lbs/hr)	Actual Emissions (lbs/yr)
CAS Number	**Contaminant Name**			
- -				
ERP (lbs/yr)	PTE Emissions (lbs/hr)	PTE Emissions (lbs/yr)	Actual Emissions (lbs/hr)	Actual Emissions (lbs/yr)

DEC ID											
2	-	6	3	0	1	-	0	0	1	9	1

Section IV - Emission Unit Information

Emission Unit Description (continuation)

Emission Unit	U	-	E	G	E	N	S

This emission unit consists of three emergency-use ULSD-fired engines. A 500 electric kilowatt emergency generator with a 555 mechanical kilowatt engine, a 117 mechanical kilowatt fire pump engine, and a 177 mechanical kilowatt fire pump engine.

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Emission Point Information

☒Continuation Sheet(s)

Emission Point	STK01					
Ground Elevation (ft)	Height (ft)	Height Above Structure (ft)	Inside Diameter (in)	Exit Temp. (°F)	Cross Section Length (in)	Cross Section Width (in)
19	250	155	342	840		
Exit Velocity (FPS)	Exit Flow (ACFM)	NYTM (E) (KM)	NYTM (N) (KM)	Building	Distance to Property Line (ft)	Date of Removal
131	5,014,840	592.290	4515.836	CTG INLET	58	
Emission Point	FIRE1					
Ground Elevation (ft)	Height (ft)	Height Above Structure (ft)	Inside Diameter (in)	Exit Temp. (°F)	Cross Section Length (in)	Cross Section Width (in)
19	17	7	4	809		
Exit Velocity (FPS)	Exit Flow (ACFM)	NYTM (E) (KM)	NYTM (N) (KM)	Building	Distance to Property Line (ft)	Date of Removal
141.9	743	592.506	4515.638	FP BLDG	120	
Emission Point	FIRE2					
Ground Elevation (ft)	Height (ft)	Height Above Structure (ft)	Inside Diameter (in)	Exit Temp. (°F)	Cross Section Length (in)	Cross Section Width (in)
19	17	7	6	809		
Exit Velocity (FPS)	Exit Flow (ACFM)	NYTM (E) (KM)	NYTM (N) (KM)	Building	Distance to Property Line (ft)	Date of Removal
95.4	1124	592.503	4515.634	FP BLDG	120	

Emission Source/Control Information

☒ Continuation Sheet(s)

Emission Source ID	Emission Source Type	Date of Construction	Date of Operation	Date of Removal	Control Type Code	Control Type Description	Manufacturer's Name/Model Number	
CTG01	C						General Electric 7HA.03	
Design Capacity	Design Capacity Units Code	Design Capacity Units Description			Waste Feed Code	Waste Feed Description	Waste Type Code	Waste Type Description
3,996	25	Million BTU per Hour						
Emission Source ID	Emission Source Type	Date of Construction	Date of Operation	Date of Removal	Control Type Code	Control Type Description	Manufacturer's Name/Model Number	
SCR01	K				033	Selective Catalytic Reduction		
Design Capacity	Design Capacity Units Code	Design Capacity Units Description			Waste Feed Code	Waste Feed Description	Waste Type Code	Waste Type Description
Emission Source ID	Emission Source Type	Date of Construction	Date of Operation	Date of Removal	Control Type Code	Control Type Description	Manufacturer's Name/Model Number	
CAT01	K				110	Catalytic Oxidation		
Design Capacity	Design Capacity Units Code	Design Capacity Units Description			Waste Feed Code	Waste Feed Description	Waste Type Code	Waste Type Description

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Section IV - Emission Unit Information

Emission Point Information (Continuation)

Emission Unit	U-EGENS			Emission Point	EGEN1	
Ground Elevation (ft)	Height (ft)	Height Above Structure (ft)	Inside Diameter (in)	Exit Temp. (°F)	Cross Section Length (in)	Cross Section Width (in)
19	13		8	787		
Exit Velocity (FPS)	Exit Flow (ACFM)	NYTM (E) (KM)	NYTM (N) (KM)	Building	Distance to Property Line (ft)	Date of Removal
118	2,389	592.324	4515.744		167	
Emission Unit	-			Emission Point		
Ground Elevation (ft)	Height (ft)	Height Above Structure (ft)	Inside Diameter (in)	Exit Temp. (°F)	Cross Section Length (in)	Cross Section Width (in)
Exit Velocity (FPS)	Exit Flow (ACFM)	NYTM (E) (KM)	NYTM (N) (KM)	Building	Distance to Property Line (ft)	Date of Removal
Emission Unit	-			Emission Point		
Ground Elevation (ft)	Height (ft)	Height Above Structure (ft)	Inside Diameter (in)	Exit Temp. (°F)	Cross Section Length (in)	Cross Section Width (in)
Exit Velocity (FPS)	Exit Flow (ACFM)	NYTM (E) (KM)	NYTM (N) (KM)	Building	Distance to Property Line (ft)	Date of Removal
Emission Unit	-			Emission Point		
Ground Elevation (ft)	Height (ft)	Height Above Structure (ft)	Inside Diameter (in)	Exit Temp. (°F)	Cross Section Length (in)	Cross Section Width (in)
Exit Velocity (FPS)	Exit Flow (ACFM)	NYTM (E) (KM)	NYTM (N) (KM)	Building	Distance to Property Line (ft)	Date of Removal
Emission Unit	-			Emission Point		
Ground Elevation (ft)	Height (ft)	Height Above Structure (ft)	Inside Diameter (in)	Exit Temp. (°F)	Cross Section Length (in)	Cross Section Width (in)
Exit Velocity (FPS)	Exit Flow (ACFM)	NYTM (E) (KM)	NYTM (N) (KM)	Building	Distance to Property Line (ft)	Date of Removal
Emission Unit	-			Emission Point		
Ground Elevation (ft)	Height (ft)	Height Above Structure (ft)	Inside Diameter (in)	Exit Temp. (°F)	Cross Section Length (in)	Cross Section Width (in)
Exit Velocity (FPS)	Exit Flow (ACFM)	NYTM (E) (KM)	NYTM (N) (KM)	Building	Distance to Property Line (ft)	Date of Removal

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2 - 6 3 0 1 - 0 0 1 9 1

Section IV - Emission Unit Information

EMISSION UNIT		Emission Source/Control (continuation)						
U - C T G 0 1								
Emission Source		Date of Construction	Date of Operation	Date of Removal	Control Type		Manufacturer's Name/Model No.	
ID	Type				Code	Description		
CTGWI	K				526	Water Injection		
Design Capacity	Design Capacity Units				Waste Feed		Waste Type	
	Code	Description			Code	Description	Code	Description
Emission Source		Date of Construction	Date of Operation	Date of Removal	Control Type		Manufacturer's Name/Model No.	
ID	Type				Code	Description		
CTDLN	K				103	Dry low NOx burner		
Design Capacity	Design Capacity Units				Waste Feed		Waste Type	
	Code	Description			Code	Description	Code	Description
Emission Source		Date of Construction	Date of Operation	Date of Removal	Control Type		Manufacturer's Name/Model No.	
ID	Type				Code	Description		
Design Capacity	Design Capacity Units				Waste Feed		Waste Type	
	Code	Description			Code	Description	Code	Description

EMISSION UNIT		Emission Source/Control (continuation)						
U - E G E N S								
Emission Source		Date of Construction	Date of Operation	Date of Removal	Control Type		Manufacturer's Name/Model No.	
ID	Type				Code	Description		
FIRE1	C						John Deere	
Design Capacity	Design Capacity Units				Waste Feed		Waste Type	
	Code	Description			Code	Description	Code	Description
117	213	kilowatts						
Emission Source		Date of Construction	Date of Operation	Date of Removal	Control Type		Manufacturer's Name/Model No.	
ID	Type				Code	Description		
FIRE2	C						John Deere	
Design Capacity	Design Capacity Units				Waste Feed		Waste Type	
	Code	Description			Code	Description	Code	Description
177	213	kilowatts						
Emission Source		Date of Construction	Date of Operation	Date of Removal	Control Type		Manufacturer's Name/Model No.	
ID	Type				Code	Description		
EGEN1	C						Caterpillar	
Design Capacity	Design Capacity Units				Waste Feed		Waste Type	
	Code	Description			Code	Description	Code	Description
555	213	kilowatts						

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Process Information

☐Continuation Sheet(s)

Emission Unit	U-CTG01	Process	GAS

Process Description

This process consists of the General Electric H-Class combustion turbine, model 7HA.03 firing natural gas during steady-state operation. Emissions are controlled by the turbine's dry low-NOx combustion system, selective catalytic reduction, and an oxidation catalyst.

Source Classification Code (SCC)	Total Throughput		Throughput Quantity Units	
	Quantity/Hr	Quantity/Yr	Code	Description
2-01-002-09				

☐Confidential
☐Operating at Maximum Capacity

Operating Schedule		Building	Floor/Location
Hrs/Day	Days/Yr		

Emission Point Identifier(s)

STK01							

Emission Source/Control Identifier(s)

CTG01	**SCR01**	**CAT01**	**CTDLN**				

Emission Unit	U-CTG01	Process	OIL

Process Description

This process consists of the General Electric H-Class combustion turbine, model 7HA.03 firing ULSD during steady-state operation. Emissions are controlled by an oil/water emulsion injection system, selective catalytic reduction, and an oxidation catalyst.

Source Classification Code (SCC)	Total Throughput		Throughput Quantity Units	
	Quantity/Hr	Quantity/Yr	Code	Description
2-01-001-09				

☐Confidential
☐Operating at Maximum Capacity

Operating Schedule		Building	Floor/Location
Hrs/Day	Days/Yr		

Emission Point Identifier(s)

STK01							

Emission Source/Control Identifier(s)

CTG01	**SCR01**	**CAT01**	**CTGWI**				

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Section IV - Emission Unit Information

Process Information (continuation)

Emission Unit	U-CTG01	Process	SUG

Description

This process consists of the General Electric H-Class combustion turbine, model 7HA.03 firing natural gas during startup operation. Start-up is defined as not to exceed 30 minutes in duration, beginning from the point when the flame is initiated.

The process of fuel switching is included in process SUO.

Source Classification Code (SCC)	Total Throughput		Throughput Quantity Units	
	Quantity/Hr	Quantity/Yr	Code	Description
2-01-002-09				

☐ Confidential
☐ Operating at Maximum Capacity
☐ Activity with Insignificant Emissions

Operating Schedule		Building	Floor/Location
Hrs/Day	Days/Yr		

Emission Point Identifier(s)

STK01							

Emission Source/Control Identifier(s)

CTG01	**SCR01**	**CAT01**	**CTDLN**				

Emission Unit	U-CTG01	Process	SDG

Description

This process consists of the General Electric H-Class combustion turbine, model 7HA.03 firing natural gas during shutdown operation. Shutdown is defined as commencing with sending the stop signal to the controller and ending with the cessation of fuel firing in the turbine, not to exceed 20 minutes in duration.

Source Classification Code (SCC)	Total Throughput		Throughput Quantity Units	
	Quantity/Hr	Quantity/Yr	Code	Description
2-01-002-09				

☐ Confidential
☐ Operating at Maximum Capacity
☐ Activity with Insignificant Emissions

Operating Schedule		Building	Floor/Location
Hrs/Day	Days/Yr		

Emission Point Identifier(s)

STK01							

Emission Source/Control Identifier(s)

CTG01	**SCR01**	**CAT01**	**CTDLN**				

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Section IV - Emission Unit Information

Process Information (continuation)

Emission Unit: U-CTG01 **Process:** SUO

Description

This process consists of the General Electric H-Class combustion turbine, model 7HA.03 firing ULSD during startup operation. Start-up is defined as not to exceed 30 minutes in duration, beginning from the point when the flame is initiated.

This process also includes fuel switching from natural gas to ULSD or from ULSD to natural gas.

Source Classification Code (SCC)	Total Throughput Quantity/Hr	Total Throughput Quantity/Yr	Throughput Quantity Units Code	Throughput Quantity Units Description
2-01-001-09				

☐ Confidential
☐ Operating at Maximum Capacity
☐ Activity with Insignificant Emissions

Operating Schedule Hrs/Day	Operating Schedule Days/Yr	Building	Floor/Location

Emission Point Identifier(s)

STK01							

Emission Source/Control Identifier(s)

CTG01	SCR01	CAT01	CTGWI				

Emission Unit: U-CTG01 **Process:** SDO

Description

This process consists of the General Electric H-Class combustion turbine, model 7HA.03 firing ULSD during shutdown operation. Shutdown is defined as commencing with sending the stop signal to the controller and ending with the cessation of fuel firing in the turbine, not to exceed 20 minutes in duration.

Source Classification Code (SCC)	Total Throughput Quantity/Hr	Total Throughput Quantity/Yr	Throughput Quantity Units Code	Throughput Quantity Units Description
2-01-001-09				

☐ Confidential
☐ Operating at Maximum Capacity
☐ Activity with Insignificant Emissions

Operating Schedule Hrs/Day	Operating Schedule Days/Yr	Building	Floor/Location

Emission Point Identifier(s)

STK01							

Emission Source/Control Identifier(s)

CTG01	SCR01	CAT01	CTGWI				

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Section IV - Emission Unit Information

Process Information (continuation)

Emission Unit	U-EGENS	Process	EME

Description

This process represents the three emergency-use ULSD-fired engines operating for testing, maintenance, or emergency use. FIRE1 and FIRE2 each serves a fire system pump. EGEN1 provides emergency backup electric power.

Source Classification Code (SCC)	Total Throughput Quantity/Hr	Total Throughput Quantity/Yr	Throughput Quantity Units Code	Throughput Quantity Units Description
2-01-001-02				

☐ Confidential
☐ Operating at Maximum Capacity
☐ Activity with Insignificant Emissions

Operating Schedule Hrs/Day	Operating Schedule Days/Yr	Building	Floor/Location

Emission Point Identifier(s)

FIRE1	FIRE2	EGEN1					

Emission Source/Control Identifier(s)

FIRE1	FIRE2	EGEN1					

Emission Unit	A-00005	Process	BLK

Description

This process consists of a Pratt & Whitney Twin Pac unit with two individual combustion turbines (GT24A & GT24B) operating on either natural gas or ULSK. The P&W turbines will be used for providing electricity to the H-Class combustion turbine during black start periods. The P&W turbines will not provide electric power to the grid after the Project's shakedown period. The P&W turbines will be limited to operating 12 hours per year per turbine.

Source Classification Code (SCC)	Total Throughput Quantity/Hr	Total Throughput Quantity/Yr	Throughput Quantity Units Code	Throughput Quantity Units Description

☐ Confidential
☐ Operating at Maximum Capacity
☐ Activity with Insignificant Emissions

Operating Schedule Hrs/Day	Operating Schedule Days/Yr	Building	Floor/Location

Emission Point Identifier(s)

GT41A	GT41B						

Emission Source/Control Identifier(s)

GT41A	GT41B						

Section IV - Emission Unit Information

Process Information (continuation)

Emission Unit A-00005 **Process** CNG

Description

This process includes the combustion of natural gas in the 24 Pratt & Whitney combustion turbines: GT21A, GT21B, through GT24A, GT24B, GT31A, GT31B, through GT34A, GT34B; AND, GT41A, GT41B, through GT44A, GT44B, which are rated at 255 MMBtu/hr each. 22 of the P&W turbines will cease operation after the Project's shakedown period. GT41A and GT41B will remain operational until replaced by a battery energy storage system, but be restricted to testing, maintenance, and black start operation in a separate process.

Source Classification Code (SCC)	Total Throughput Quantity/Hr	Total Throughput Quantity/Yr	Throughput Quantity Units Code	Throughput Quantity Units Description
2-02-007-01				

☐ Confidential
☐ Operating at Maximum Capacity
☐ Activity with Insignificant Emissions

Operating Schedule Hrs/Day	Operating Schedule Days/Yr	Building	Floor/Location

Emission Point Identifier(s)

GT21A	GT21B	GT22A	GT22B	GT23A	GT23B	GT24A	GT24B
GT31A	GT31B	GT32A	GT32B	GT33A	GT33B	GT34A	GT34B
GT41A	GT41B	GT42A	GT42B	GT43A	GT43B	GT44A	GT44B

Emission Source/Control Identifier(s)

GT21A	GT21B	GT22A	GT22B	GT23A	GT23B	GT24A	GT24B
GT31A	GT31B	GT32A	GT32B	GT33A	GT33B	GT34A	GT34B
GT41A	GT41B	GT42A	GT42B	GT43A	GT43B	GT44A	GT44B

Emission Unit A-00005 **Process** GTD

Description

This process includes the combustion of ULSK in the 24 Pratt & Whitney combustion turbines: GT21A, GT21B, through GT24A, GT24B; GT31A, GT31B, through GT34A, GT34B; AND, GT41A, GT41B, through GT44A, GT44B, which are rated at 255 MMBtu/hr each. 22 of the P&W turbines will cease operation after the Project's shakedown period. GT41A and GT41B will remain operational until replaced by a battery energy storage system but be restricted to testing, maintenance, and black start operation in a separate process.

Source Classification Code (SCC)	Total Throughput Quantity/Hr	Total Throughput Quantity/Yr	Throughput Quantity Units Code	Throughput Quantity Units Description
2-02-009-01				

☐ Confidential
☐ Operating at Maximum Capacity
☐ Activity with Insignificant Emissions

Operating Schedule Hrs/Day	Operating Schedule Days/Yr	Building	Floor/Location

Emission Point Identifier(s)

GT21A	GT21B	GT22A	GT22B	GT23A	GT23B	GT24A	GT24B
GT31A	GT31B	GT32A	GT32B	GT33A	GT33B	GT34A	GT34B
GT41A	GT41B	GT42A	GT42B	GT43A	GT43B	GT44A	GT44B

Emission Source/Control Identifier(s)

GT21A	GT21B	GT22A	GT22B	GT23A	GT23B	GT24A	GT24B
GT31A	GT31B	GT32A	GT32B	GT33A	GT33B	GT34A	GT34B
GT41A	GT41B	GT42A	GT42B	GT43A	GT43B	GT44A	GT44B

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Process Emissions Summary

☐ Continuation Sheet(s)

Emission Unit	-						Process	
CAS Number	Contaminant Name	% Thruput	% Capture	% Control	ERP (lbs/hr)	ERP How Determined		
Potential to Emit			Standard Units	Potential to Emit How Determined	Actual Emissions			
(lbs/hr)	(lbs/yr)	(standard units)			(lbs/hr)	(lbs/yr)		
Emission Unit	-						Process	
CAS Number	Contaminant Name	% Thruput	% Capture	% Control	ERP (lbs/hr)	ERP How Determined		
Potential to Emit			Standard Units	Potential to Emit How Determined	Actual Emissions			
(lbs/hr)	(lbs/yr)	(standard units)			(lbs/hr)	(lbs/yr)		
Emission Unit	-						Process	
CAS Number	Contaminant Name	% Thruput	% Capture	% Control	ERP (lbs/hr)	ERP How Determined		
Potential to Emit			Standard Units	Potential to Emit How Determined	Actual Emissions			
(lbs/hr)	(lbs/yr)	(standard units)			(lbs/hr)	(lbs/yr)		

Emission Source Emissions Summary

☐ Continuation Sheet(s)

Emission Source							Process	
CAS Number	Contaminant Name	% Thruput	% Capture	% Control	ERP (lbs/hr)	ERP How Determined		
Potential to Emit			Standard Units	Potential to Emit How Determined	Actual Emissions			
(lbs/hr)	(lbs/yr)	(standard units)			(lbs/hr)	(lbs/yr)		
Emission Source							Process	
CAS Number	Contaminant Name	% Thruput	% Capture	% Control	ERP (lbs/hr)	ERP How Determined		
Potential to Emit			Standard Units	Potential to Emit How Determined	Actual Emissions			
(lbs/hr)	(lbs/yr)	(standard units)			(lbs/hr)	(lbs/yr)		
Emission Source							Process	
CAS Number	Contaminant Name	% Thruput	% Capture	% Control	ERP (lbs/hr)	ERP How Determined		
Potential to Emit			Standard Units	Potential to Emit How Determined	Actual Emissions			
(lbs/hr)	(lbs/yr)	(standard units)			(lbs/hr)	(lbs/yr)		

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Emission Unit	Emission Point	Process	Emission Source	Emission Unit Applicable Federal Requirements ☐Continuation Sheet(s)									
				Title	Type	Part	Sub Part	Section	Subdiv	Parag.	Subparag.	Clause	Subcl.
U - CTG01				40	CFR	60	TTTT						
U - EGENS				40	CFR	60	IIII						
U - EGENS				40	CFR	63	ZZZZ						
-													
-													

Emission Unit	Emission Point	Process	Emission Source	Emission Unit State Only Requirements ☐Continuation Sheet(s)									
				Title	Type	Part	Sub Part	Section	Subdiv	Parag.	Subparag.	Clause	Subcl.
-													
-													
-													
-													
-													

Emission Unit Compliance Certification

☒Continuation Sheet(s)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	NYCRR	200	6						

☒ Applicable Federal Requirement ☐ State Only Requirement ☐ Capping

Emission Unit	Emission Point	Process	Emission Source	CAS Number	Contaminant Name
A - 00005		GTD		- -	

Monitoring Information

☐Continuous Emission Monitoring
☐Intermittent Emission Testing
☐ Ambient Air Monitoring
☐ Monitoring of Process or Control Device Parameters as Surrogate
☐ Work Practice Involving Specific Operations
☒ Record Keeping/Maintenance Procedures

Compliance Activity Description

The operation of the turbines at the facility, when firing oil, is limited as follows:

(1) on a daily basis, the operation of each of the Pratt and Whitney turbines cannot exceed 14 hours per day when firing distillate oil. This limit is only for the combustion of distillate fuel (ULSK) in the following 24 combustion turbines: GT21A, GT21B, through GT24A, GT24B; GT31A, GT31B, through GT34A, GT34B; and, GT41A, GT41B, through GT44A, GT44B, which are rated at 255 MMBTU/hr each.

(2) on an annual basis, the operation of each turbine cannot exceed 1,930 hours per year.

Records must be kept and submitted quarterly, for each turbine at the facility, indicating the total hours of operation on a daily basis and the annual, 365-day rolling total of hours of operation.

This condition will cease to be applicable once the combustion turbines covered under Emission Unit A-00005 have permanently shut down (with the exception of turbines GT41A and GT41B which shall remain to provide black start capability for CTG01 and which are subject to separate permit conditions).

Work Practice Type Code	Process Material Code	Process Material Description	Reference Test Method

Parameter Code	Parameter Description	Manufacturer Name/Model No.

Limit Upper	Limit Lower	Limit Units Code	Limit Units Description

Averaging Method Code	Averaging Method Description	Monitoring Frequency Code	Monitoring Frequency Description	Reporting Requirements Code	Reporting Requirements Description
		02	Hourly	13	Quarterly (Calendar)

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Section IV - Emission Unit Information

Emission Unit Compliance Certification (continuation)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	NYCRR	227		2	b	1			

☒ **Applicable Federal Requirement** ☐ State Only Requirement ☐ Capping

Emission Unit	Emission Point	Process	Emission Source	CAS No.	Contaminant Name
A - 00005		GTD		0NY075 - 00 - 0	Particulates

Monitoring Information

☐ Continuous Emission Monitoring
☒ **Intermittent Emission Testing**
☐ Ambient Air Monitoring
☐ Monitoring of Process or Control Device Parameters as Surrogate
☐ Work Practice Involving Specific Operations
☐ Record Keeping/Maintenance Procedures

Description

Particulate emission limit for a stationary combustion installation firing oil. The owner or operator shall complete the following once per term of this permit:

1) submit, to the Department, an acceptable protocol for the testing of particulate emission limit cited in this condition,

2) perform a stack test, based upon the approved test protocol, to determine compliance with the particulate emission limit cited in this condition, and

3) all records shall be maintained at the facility for a minimum of five years.

This condition will cease to be applicable once the combustion turbines covered under Emission Unit A-00005 have permanently shut down (with the exception of turbines GT41A and GT41B which shall remain to provide black start capability for CTG01 until replaced by a battery energy storage system and which are subject to separate permit conditions).

Work Practice Type	Process Material Code	Process Material Description	Reference Test Method
			EPA Method 5

Parameter Code	Parameter Code	Manufacturer Name/Model No.

Limit Upper	Limit Lower	Limit Units Code	Limit Units Description
0.10		7	Pounds per million BTU

Averaging Method Code	Averaging Method Description	Monitoring Frequency Code	Monitoring Frequency Description	Reporting Requirements Code	Reporting Requirements Description
20	Per test method	17	Once per permit	14	Semi-Annually (Calendar)

Section IV - Emission Unit Information

Emission Unit Compliance Certification (continuation)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	NYCRR	231	8	7					

☒ **Applicable Federal Requirement** ☐ State Only Requirement ☐ Capping

Emission Unit	Emission Point	Process	Emission Source	CAS No.	Contaminant Name
A - 00005		BLK		- -	

Monitoring Information

☐ Continuous Emission Monitoring
☐ Intermittent Emission Testing
☐ Ambient Air Monitoring
☐ Monitoring of Process or Control Device Parameters as Surrogate
☐ Work Practice Involving Specific Operations
☒ **Record Keeping/Maintenance Procedures**

Description

The Pratt & Whitney turbines GT41A and GT41B will be limited to operating as black start units after the Project's shakedown period is completed and until replaced by a battery energy storage system. Operation of the turbines will be limited to 12 hours per year, per turbine, on a rolling 12-month basis.

The facility shall maintain records on site of turbine operation and include a summary report in the semi-annual monitoring report.

Work Practice Type	Process Material Code	Process Material Description	Reference Test Method

Parameter Code	Parameter Code	Manufacturer Name/Model No.

Limit Upper	Limit Lower	Limit Units Code	Limit Units Description
12		28	Hours

Averaging Method Code	Averaging Method Description	Monitoring Frequency Code	Monitoring Frequency Description	Reporting Requirements Code	Reporting Requirements Description
17	Annual max rolled monthly	05	Monthly	14	Semi-Annually (Calendar)

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Section IV - Emission Unit Information

Emission Unit Compliance Certification (continuation)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	NYCRR	251		3	a				

☐ Applicable Federal Requirement ☒ **State Only Requirement** ☐ Capping

Emission Unit	Emission Point	Process	Emission Source	CAS No.	Contaminant Name
U - CTG01			CTG01	000124 - 38 - 9	Carbon Dioxide

Monitoring Information

☒ **Continuous Emission Monitoring**
☐ Intermittent Emission Testing
☐ Ambient Air Monitoring
☐ Monitoring of Process or Control Device Parameters as Surrogate
☐ Work Practice Involving Specific Operations
☐ Record Keeping/Maintenance Procedures

Description

Owners or operators of new simple cycle combustion turbines are required to meet an emission rate of 160 pounds of CO2 per million Btu of input (input-based limit). This emission limit is measured on an annual basis, calculated by dividing the annual total of CO2 emissions for the calendar year by the annual total Btus (input-based limit) fired for each separate fossil fuel fired. The owner or operator must maintain all records associated with these requirements on site or at a location acceptable to the Department for a minimum of five years.

This facility will monitor CO2 emissions using the calculation methods specified in 40 CFR 75.13(a) and will determine the heat value of each fuel using the methodology listed in Appendix D of Part 75 as specified in 40CFR75.71(c)(2).

The owner or operator shall report the CO2 mass emissions data and heat input data in a format appropriate for comparison to the applicable emission limit, in lb/MMbtu heat input, for each calendar quarter. Reports are due within 30 days following the end of the calendar quarter. The reports to EPA shall be submitted in the manner specified in subpart H of 40 CFR part 75 and 40 CFR 75.64 and include all the data and information required in subpart H and G of 40 CFR part 75. Submit the Emission Monitoring data feedback reports received from the EPA Emissions Collection and Monitoring Plan System (ECMPS) to the Regional DEC office quarterly. These reports verify that data was submitted to EPA and include the hours of operation, heat input and CO2 emissions. [251.6(e)].

A compliance certification shall be submitted in support of each quarterly report as required by 6 NYCRR Part 251.6(a) and (g). Part 251.6(a) includes a specific certification statement to include with all submissions.

The owner or operator shall report the annual CO2 mass emissions and heat input data in a format appropriate for comparison to the emission limit within 30 days following the end of the calendar year. [251.3]

Work Practice Type	Process Material Code	Process Material Description	Reference Test Method
			40 CFR Part 75 Appendix B

Parameter Code	Parameter Description	Manufacturer Name/Model No.
		TBD

Limit Upper	Limit Lower	Limit Units Code	Limit Units Description
160		7	lb/MMBtu

Averaging Method Code	Averaging Method Description	Monitoring Frequency Code	Monitoring Frequency Description	Reporting Requirements Code	Reporting Requirements Description
45	Calendar year average	01	Continuous	15	Annually (Calendar)

DEC ID
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Section IV - Emission Unit Information

Emission Unit Compliance Certification (continuation)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	NYCRR	251		3	b				

☐ Applicable Federal Requirement ☒ **State Only Requirement** ☐ Capping

Emission Unit	Emission Point	Process	Emission Source	CAS No.	Contaminant Name
A - 00005				000124 - 38 - 9	Carbon Dioxide

Monitoring Information

☐ Continuous Emission Monitoring
☐ Intermittent Emission Testing
☐ Ambient Air Monitoring
☒ **Monitoring of Process or Control Device Parameters as Surrogate**
☐ Work Practice Involving Specific Operations
☐ Record Keeping/Maintenance Procedures

Description

On or after December 31, 2020, owners or operators of non-modified existing sources shall not fire any single fossil fuel, alone or in combination with any other fuel, where each fossil fuel is required to meet an emission rate of 180 pounds of CO2 per million Btu of input (input-based limit). These emission limits are measured on an annual basis, calculated by dividing the annual total of CO2 emissions for the calendar year by the annual total Btus (input-based limit) fired for each separate fossil fuel fired. The owner or operator must maintain all records associated with these requirements on site or at a location acceptable to the Department for a minimum of five years.

This facility will monitor CO2 emissions and heat input using the calculation methods specified in 40 CFR 75.13(d). CO2 emissions are calculated using 40 CFR 75.19(c)(4)(iii) and heat input is determined for each fuel using the methodology listed in 40 CFR 75.19(c)(3)(ii).

The owner or operator shall report the CO2 mass emissions data and heat input data in a format appropriate for comparison to the applicable emission limit, in lb/MMbtu heat input, for each calendar quarter. Reports are due within 30 days following the end of the calendar quarter. The reports to EPA shall be submitted in the manner specified in subpart H of 40 CFR part 75 and 40 CFR 75.64 and include all the data and information required in subpart H and G of 40 CFR part 75. Submit the Emission Monitoring data feedback reports received from the EPA Emissions Collection and Monitoring Plan System (ECMPS) to the Regional DEC office quarterly. These reports verify that data was submitted to EPA and include the hours of operation, heat input and CO2 emissions. [251.6(e)].

A compliance certification shall be submitted in support of each quarterly report as required by 6 NYCRR Part 251.6(a) and (g). Part 251.6(a) includes a specific certification statement to include with all submissions.

The owner or operator shall report the annual CO2 mass emissions and heat input data in a format appropriate for comparison to the emission limit within 30 days following the end of the calendar year. [251.3]

This condition will cease to be applicable once the combustion turbines covered under Emission Unit A-00005 have permanently shut down. This condition will also cease to be applicable to the two remaining black-start turbines (GT24A and GT24B) once the Project completes its shakedown period because GT24A and GT24B will no longer be subject to Subpart 251 (as black-start units, GT24A and GT24B will not be selling power to the grid).

Work Practice	Process Material		Reference Test Method
Type	Code	Description	

Parameter		Manufacturer Name/Model No.
Code	Code	
38	Heat Input	

Limit		Limit Units	
Upper	Lower	Code	Description
180		7	lb/MMBtu

Averaging Method		Monitoring Frequency		Reporting Requirements	
Code	Description	Code	Description	Code	Description
45	Calendar year average	01	Continuous	15	Annually (Calendar)

DEC ID
2 - 6 3 0 1 - 0 0 1 9 1

Section IV - Emission Unit Information

Emission Unit Compliance Certification (continuation)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
40	CFR	60	KKKK	4320	a				

☐ Applicable Federal Requirement ☐ State Only Requirement ☐ Capping

Emission Unit	Emission Point	Process	Emission Source	CAS No.	Contaminant Name
U - CTG01		OIL	CTG01	0NY210 - 00 - 0	Oxides of Nitrogen

Monitoring Information

☒ **Continuous Emission Monitoring**
☐ Intermittent Emission Testing
☐ Ambient Air Monitoring
☐ Monitoring of Process or Control Device Parameters as Surrogate
☐ Work Practice Involving Specific Operations
☐ Record Keeping/Maintenance Procedures

Description

For a facility with a combustion turbine that meets the following criteria:

1) Commences construction after February 18, 2005,

2) Firing fuels other than natural gas, and

3) The combustion turbine has a heat input at peak load (HHV) that is greater than or equal to 850 mmBtu/hr.

The facility must not exceed the NOx emission standard of 42 ppm at 15% O2. Compliance with this emission standard shall be determined through the use of a continuous emissions monitor as stated in §60.4335(b)(1), operated according to the requirements in §60.4345, and then compared to the emission limit as stated in §60.4350.

Work Practice Type	Process Material Code	Process Material Description	Reference Test Method
			Part 60 Appx. B & F

Parameter Code	Parameter Code	Manufacturer Name/Model No.
		TBD

Limit Upper	Limit Lower	Limit Units Code	Limit Units Description
42		275	ppmvd @ 15% O2

Averaging Method Code	Averaging Method Description	Monitoring Frequency Code	Monitoring Frequency Description	Reporting Requirements Code	Reporting Requirements Description
36	30 day rolling average	01	Continuous	14	Semi-Annually (Calendar)

New York State Department of Environmental Conservation
Air Permit Application

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DEC ID
2 - 6 3 0 1 - 0 0 1 9 1

Section IV - Emission Unit Information

Emission Unit Compliance Certification (continuation)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
40	CFR	60	KKKK	4320	a				

☐ Applicable Federal Requirement ☐ State Only Requirement ☐ Capping

Emission Unit	Emission Point	Process	Emission Source	CAS No.	Contaminant Name
U - CTG01		GAS	CTG01	0NY210 - 00 - 0	Oxides of Nitrogen

Monitoring Information

☒ **Continuous Emission Monitoring**
☐ Intermittent Emission Testing
☐ Ambient Air Monitoring
☐ Monitoring of Process or Control Device Parameters as Surrogate
☐ Work Practice Involving Specific Operations
☐ Record Keeping/Maintenance Procedures

Description

For a facility with a combustion turbine that meets the following criteria:

1) Commences construction after February 18, 2005,

2) Firing natural gas, and

3) The combustion turbine has heat input at peak load (HHV) that is greater than or equal to 850 mmBtu/hr.

The facility must not exceed the NOx emission standard of 15 ppm at 15% O2. Compliance with this emission standard shall be determined through the use of a continuous emissions monitor as stated in §60.4335(b)(1), operated according to the requirements in §60.4345, and then compared to the emission limit as stated in §60.4350.

Work Practice Type	Process Material Code	Process Material Description	Reference Test Method
			Part 60 Appx. B & F

Parameter Code	Parameter Code	Manufacturer Name/Model No.
		TBD

Limit Upper	Limit Lower	Limit Units Code	Limit Units Description
15		275	ppmvd @ 15% O2

Averaging Method Code	Averaging Method Description	Monitoring Frequency Code	Monitoring Frequency Description	Reporting Requirements Code	Reporting Requirements Description
36	30 day rolling average	01	Continuous	14	Semi-Annually (Calendar)

Section IV - Emission Unit Information

Emission Unit Compliance Certification (continuation)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
40	CFR	60	KKKK	4365	a				

☒ **Applicable Federal Requirement** ☐ State Only Requirement ☐ Capping

Emission Unit	Emission Point	Process	Emission Source	CAS No.	Contaminant Name
U - CTG01			CTG01	007446 - 09 - 5	Sulfur Dioxide

Monitoring Information

☐ Continuous Emission Monitoring
☐ Intermittent Emission Testing
☐ Ambient Air Monitoring
☒ **Monitoring of Process or Control Device Parameters as Surrogate**
☐ Work Practice Involving Specific Operations
☐ Record Keeping/Maintenance Procedures

Description

The facility may elect not to monitor the total sulfur content of the fuel combusted in the turbine, if the fuel is demonstrated not to exceed potential sulfur emissions of 26 ng SO2/J (0.060 lb SO2/mmBtu) heat input.

The facility must use the fuel quality characteristics in a current, valid purchase contract, tariff sheet, or transportation contract for the fuel, specifying that:

1) The maximum total sulfur content for oil use is 0.05% by weight (500 ppmw) or less, or

2) The total sulfur content for natural gas use is 20 grains of sulfur or less per 100 standard cubic feet, or 3) Has potential sulfur emissions of less than 26 ng SO2/J (0.060 lb SO2/mmBtu) heat input.

Work Practice Type	Process Material Code	Process Material Description	Reference Test Method

Parameter Code	Parameter Code	Manufacturer Name/Model No.

Limit Upper	Limit Lower	Limit Units Code	Limit Units Description

Averaging Method Code	Averaging Method Description	Monitoring Frequency Code	Monitoring Frequency Description	Reporting Requirements Code	Reporting Requirements Description
01	Maximum not to exceed	11	Per delivery	14	Semi-Annually (calendar)

DEC ID
2 - 6 3 0 1 - 0 0 1 9 1

Section IV - Emission Unit Information

Emission Unit Compliance Certification (continuation)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	NYCRR	231	8	7					

☒ **Applicable Federal Requirement** ☐ State Only Requirement ☐ Capping

Emission Unit	Emission Point	Process	Emission Source	CAS No.	Contaminant Name
U - EGENS				0NY750 - 00 - 0	Carbon Dioxide Equivalents

Monitoring Information

☐ Continuous Emission Monitoring	☐ Monitoring of Process or Control Device Parameters as Surrogate
☐ Intermittent Emission Testing	☐ Work Practice Involving Specific Operations
☐ Ambient Air Monitoring	☒ **Record Keeping/Maintenance Procedures**

Description

Each of the three emergency use engines will be limited to 500 hours per year of operation inclusive of testing, maintenance, and emergency operation. This will allow the engines to limit annual CO2e emissions to BACT levels:

FIRE1 – 48 tpy CO2e

FIRE2 – 73 tpy CO2e

EGEN1 – 204 tpy CO2e

Each engine shall be equipped with a non-resettable hour meter. A summary report of the hours of operation of each engine shall be included in the facility's semi-annual monitoring report.

Work Practice Type	Process Material Code	Process Material Description	Reference Test Method

Parameter Code	Parameter Code	Manufacturer Name/Model No.

Limit Upper	Limit Lower	Limit Units Code	Limit Units Description
500			Hours per year

Averaging Method Code	Averaging Method Description	Monitoring Frequency Code	Monitoring Frequency Description	Reporting Requirements Code	Reporting Requirements Description
37	Annual max rolled monthly	01	Continuous	14	Semi-Annually (Calendar)

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DEC ID
2 - 6 3 0 1 - 0 0 1 9 1

Section IV - Emission Unit Information

Emission Unit Compliance Certification (continuation)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	NYCRR	231	8	7					

☒ **Applicable Federal Requirement** ☐ State Only Requirement ☐ Capping

Emission Unit	Emission Point	Process	Emission Source	CAS No.	Contaminant Name
U - EGENS			FIRE1	0NY075 - 00 - 5	PM10
U - EGENS			FIRE1	0NY075 - 02 - 5	PM2.5

Monitoring Information

☐ Continuous Emission Monitoring
☐ Intermittent Emission Testing
☐ Ambient Air Monitoring
☐ Monitoring of Process or Control Device Parameters as Surrogate
☐ Work Practice Involving Specific Operations
☒ **Record Keeping/Maintenance Procedures**

Description

The permittee shall purchase a fire pump which is certified to be in compliance with NSPS Subpart IIII particulate emissions requirements for fire pump engines with maximum power range between 75 and 130 kWm. A copy of the certification shall be maintained onsite.

Work Practice Type	Process Material Code	Process Material Description	Reference Test Method

Parameter Code	Parameter Code	Manufacturer Name/Model No.

Limit Upper	Limit Lower	Limit Units Code	Limit Units Description
0.3			Grams per kilowatt-hour

Averaging Method Code	Averaging Method Description	Monitoring Frequency Code	Monitoring Frequency Description	Reporting Requirements Code	Reporting Requirements Description
63	See monitoring description	13	Single Occurrence	15	Annually (Calendar)

DEC ID
2 - 6 3 0 1 - 0 0 1 9 1

Section IV - Emission Unit Information

Emission Unit Compliance Certification (continuation)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	NYCRR	231	8	7					

☒ **Applicable Federal Requirement** ☐ State Only Requirement ☐ Capping

Emission Unit	Emission Point	Process	Emission Source	CAS No.	Contaminant Name
U - EGENS			FIRE2	0NY075 - 00 - 5	PM10
U - EGENS			FIRE2	0NY075 - 02 - 5	PM2.5

Monitoring Information

☐ Continuous Emission Monitoring
☐ Intermittent Emission Testing
☐ Ambient Air Monitoring
☐ Monitoring of Process or Control Device Parameters as Surrogate
☐ Work Practice Involving Specific Operations
☒ **Record Keeping/Maintenance Procedures**

Description

The permittee shall purchase a fire pump which is certified to be in compliance with NSPS Subpart IIII particulate emissions requirements for fire pump engines with maximum power range between 130 and 225 kWm. A copy of the certification shall be maintained onsite.

Work Practice Type	Process Material Code	Process Material Description	Reference Test Method

Parameter Code	Parameter Code	Manufacturer Name/Model No.

Limit Upper	Limit Lower	Limit Units Code	Limit Units Description
0.2			Grams per kilowatt-hour

Averaging Method Code	Averaging Method Description	Monitoring Frequency Code	Monitoring Frequency Description	Reporting Requirements Code	Reporting Requirements Description
63	See monitoring description	13	Single Occurrence	15	Annually (Calendar)

New York State Department of Environmental Conservation
Air Permit Application

New York State of Opportunity | Department of Environmental Conservation

DEC ID
2-6301-00191

Section IV - Emission Unit Information

Emission Unit Compliance Certification (continuation)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	NYCRR	231	8	7					

☒ **Applicable Federal Requirement** ☐ State Only Requirement ☐ Capping

Emission Unit	Emission Point	Process	Emission Source	CAS No.	Contaminant Name
U - EGENS			EGEN1	0NY075 - 00 - 5	PM10
U - EGENS			EGEN1	0NY075 - 02 - 5	PM2.5

Monitoring Information

☐ Continuous Emission Monitoring
☐ Intermittent Emission Testing
☐ Ambient Air Monitoring
☐ Monitoring of Process or Control Device Parameters as Surrogate
☐ Work Practice Involving Specific Operations
☒ **Record Keeping/Maintenance Procedures**

Description

The permittee shall purchase an emergency generator which is certified to be in compliance with NSPS Subpart IIII particulate emissions requirements for USEPA Tier 4 engines. A copy of the certification shall be maintained onsite.

Work Practice Type	Process Material Code	Process Material Description	Reference Test Method

Parameter Code	Parameter Code	Manufacturer Name/Model No.

Limit Upper	Limit Lower	Limit Units Code	Limit Units Description
0.03			Grams per kilowatt-hour

Averaging Method Code	Averaging Method Description	Monitoring Frequency Code	Monitoring Frequency Description	Reporting Requirements Code	Reporting Requirements Description
63	See monitoring description	13	Single Occurrence	15	Annually (Calendar)

Section IV – Emission Unit Information

Emission Unit Compliance Certification (continuation)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	NYCRR	231	8	7					

☒ **Applicable Federal Requirement** ☐ State Only Requirement ☐ Capping

Emission Unit	Emission Point	Process	Emission Source	CAS No.	Contaminant Name
U - CTG01		GAS	CTG01	0NY075 - 00 - 5	PM10
U - CTG01		GAS	CTG01	0NY075 - 02 - 5	PM2.5

Monitoring Information

☐ Continuous Emission Monitoring
☒ **Intermittent Emission Testing**
☐ Ambient Air Monitoring
☐ Monitoring of Process or Control Device Parameters as Surrogate
☐ Work Practice Involving Specific Operations
☐ Record Keeping/Maintenance Procedures

Description

Particulate emissions from U-CTG01 shall not exceed 25.3 lb/hr while firing natural gas during steady-state conditions, in order to comply with the best available control technology (BACT) requirements as stated in 6 NYCRR 231-8.7. A compliance stack test shall be performed once per permit term. The particulate emission limit of 25.3 lb/hr is applicable at turbine loads equal to or greater than 75% of full load. The limit if testing is conducted at less than 75% of full load is 16.7 lb/hr.

Stack testing using the appropriate Part 60 test methods at steady state will demonstrate compliance with permit limits.

An emissions testing protocol must be submitted to the Department prior to performing the testing.

Work Practice Type	Process Material Code	Process Material Description	Reference Test Method
			USEPA Methods 201A & 202

Parameter Code	Parameter Code	Manufacturer Name/Model No.

Limit Upper	Limit Lower	Limit Units Code	Limit Units Description
25.3		3	Pounds per hour

Averaging Method Code	Averaging Method Description	Monitoring Frequency Code	Monitoring Frequency Description	Reporting Requirements Code	Reporting Requirements Description
20	Per test method	17	Once per permit term	01	Per monitoring occurrence

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

DEC ID
2-6301-00191

Section IV – Emission Unit Information

Emission Unit Compliance Certification (continuation)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	NYCRR	231	8	7					

☒ **Applicable Federal Requirement** ☐ State Only Requirement ☐ Capping

Emission Unit	Emission Point	Process	Emission Source	CAS No.	Contaminant Name
U - CTG01		GAS	CTG01	0NY075 - 00 - 5	PM10
U - CTG01		GAS	CTG01	0NY075 - 02 - 5	PM2.5

Monitoring Information

☐ Continuous Emission Monitoring
☒ **Intermittent Emission Testing**
☐ Ambient Air Monitoring
☐ Monitoring of Process or Control Device Parameters as Surrogate
☐ Work Practice Involving Specific Operations
☐ Record Keeping/Maintenance Procedures

Description

Particulate emissions from U-CTG01 shall not exceed 0.0096 lb/MMBtu while firing natural gas during steady-state conditions, in order to comply with the best available control technology (BACT) requirements as stated in 6 NYCRR 231-8.7. A compliance stack test shall be performed once per permit term. The particulate emission limit of 0.0096 lb/MMBtu is applicable at turbine loads less than 75% of full load. The limit if testing is conducted at equal to or greater than 75% of full load is 0.0073 lb/MMBtu.

Stack testing using the appropriate Part 60 test methods at steady state will demonstrate compliance with permit limits.

An emissions testing protocol must be submitted to the Department prior to performing the testing.

Work Practice Type	Process Material Code	Process Material Description	Reference Test Method
			USEPA Methods 201A & 202

Parameter Code	Parameter Code	Manufacturer Name/Model No.

Limit Upper	Limit Lower	Limit Units Code	Limit Units Description
0.0096		**7**	**Pounds per million BTU**

Averaging Method Code	Averaging Method Description	Monitoring Frequency Code	Monitoring Frequency Description	Reporting Requirements Code	Reporting Requirements Description
20	**Per test method**	**17**	**Once per permit term**	**01**	**Per monitoring occurrence**

DEC ID
2-6301-00191

Section IV - Emission Unit Information

Emission Unit Compliance Certification (continuation)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	NYCRR	231	8	7					

☒ **Applicable Federal Requirement** ☐ State Only Requirement ☐ Capping

Emission Unit	Emission Point	Process	Emission Source	CAS No.	Contaminant Name
U - CTG01		OIL	CTG01	0NY075 - 00 - 5	PM10
U - CTG01		OIL	CTG01	0NY075 - 02 - 5	PM2.5

Monitoring Information

☐ Continuous Emission Monitoring
☒ **Intermittent Emission Testing**
☐ Ambient Air Monitoring
☐ Monitoring of Process or Control Device Parameters as Surrogate
☐ Work Practice Involving Specific Operations
☐ Record Keeping/Maintenance Procedures

Description

Particulate emissions from U-CTG01 shall not exceed 71.1 lb/hr while firing ULSD during steady-state conditions, in order to comply with the best available control technology (BACT) requirements as stated in 6 NYCRR 231-8.7. A compliance stack test shall be performed once per permit term. The particulate emission limit of 71.1 lb/hr is applicable at turbine loads equal to or greater than 75% if full load. The limit if testing is conducted at less than 75% of full load is 68.7 lb/hr.

Stack testing using the appropriate Part 60 test methods at steady state will demonstrate compliance with permit limits.

An emissions testing protocol must be submitted to the Department prior to performing the testing.

Work Practice Type	Process Material Code	Process Material Description	Reference Test Method
			USEPA Methods 201A & 202

Parameter Code	Parameter Code	Manufacturer Name/Model No.

Limit Upper	Limit Lower	Limit Units Code	Limit Units Description
71.1		3	Pounds per hour

Averaging Method Code	Averaging Method Description	Monitoring Frequency Code	Monitoring Frequency Description	Reporting Requirements Code	Reporting Requirements Description
20	Per test method	17	Once per permit term	01	Per monitoring occurrence

DEC ID
2-6301-00191

Section IV – Emission Unit Information

Emission Unit Compliance Certification (continuation)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	NYCRR	231	8	7					

☒ **Applicable Federal Requirement** ☐ State Only Requirement ☐ Capping

Emission Unit	Emission Point	Process	Emission Source	CAS No.	Contaminant Name
U - CTG01		OIL	CTG01	0NY075 - 00 - 5	PM10
U - CTG01		OIL	CTG01	0NY075 - 02 - 5	PM2.5

Monitoring Information

☐ Continuous Emission Monitoring
☒ **Intermittent Emission Testing**
☐ Ambient Air Monitoring
☐ Monitoring of Process or Control Device Parameters as Surrogate
☐ Work Practice Involving Specific Operations
☐ Record Keeping/Maintenance Procedures

Description

Particulate emissions from U-CTG01 shall not exceed 0.032 lb/MMBtu while firing ULSD during steady-state conditions, in order to comply with the best available control technology (BACT) requirements as stated in 6 NYCRR 231-8.7. A compliance stack test shall be performed once per permit term. The particulate emission limit of 0.032 lb/MMBtu is applicable at turbine loads less than 75% if full load. The limit if testing is conducted at equal to or greater than 75% of full load is 0.025 lb/MMBtu.

Stack testing using the appropriate Part 60 test methods at steady state will demonstrate compliance with permit limits.

An emissions testing protocol must be submitted to the Department prior to performing the testing.

Work Practice Type	Process Material Code	Process Material Description	Reference Test Method
			USEPA Methods 201A & 202

Parameter Code	Parameter Code	Manufacturer Name/Model No.

Limit Upper	Limit Lower	Limit Units Code	Limit Units Description
0.032		7	Pounds per million BTU

Averaging Method Code	Averaging Method Description	Monitoring Frequency Code	Monitoring Frequency Description	Reporting Requirements Code	Reporting Requirements Description
20	Per test method	17	Once per permit term	01	Per monitoring occurrence

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DEC ID
2 - 6 3 0 1 - 0 0 1 9 1

Section IV - Emission Unit Information

Emission Unit Compliance Certification (continuation)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	NYCRR	231	8	7					

☒ **Applicable Federal Requirement** ☐ State Only Requirement ☐ Capping

Emission Unit	Emission Point	Process	Emission Source	CAS No.	Contaminant Name
U - CTG01		GAS	CTG01	0NY750 - 00 - 0	Carbon Dioxide Equivalents

Monitoring Information

☐ Continuous Emission Monitoring
☐ Intermittent Emission Testing
☐ Ambient Air Monitoring
☐ Monitoring of Process or Control Device Parameters as Surrogate
☐ Work Practice Involving Specific Operations
☒ **Record Keeping/Maintenance Procedures**

Description

The permittee shall maintain the combustion turbine to meet a BACT emission limit of 1,119 lb CO2e / MW-hr (gross basis) while firing natural gas. This emission limit is based on ISO conditions at 100% load without evaporative cooling. A demonstration that the turbine meets this emission limit will be made once during the term of the permit.

The lb/MW-hr rate is based on ISO conditions (59ºF, 14.7 psia, 60% humidity).

Work Practice Type	Process Material Code	Process Material Description	Reference Test Method

Parameter Code	Parameter Code	Manufacturer Name/Model No.

Limit Upper	Limit Lower	Limit Units Code	Limit Units Description
1,119		8	Pounds per megawatt hour

Averaging Method Code	Averaging Method Description	Monitoring Frequency Code	Monitoring Frequency Description	Reporting Requirements Code	Reporting Requirements Description
63	See monitoring description	17	Once per permit term	15	Annually (calendar)

Section IV - Emission Unit Information

Emission Unit Compliance Certification (continuation)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	NYCRR	231	8	7					

☒ **Applicable Federal Requirement** ☐ State Only Requirement ☐ Capping

Emission Unit	Emission Point	Process	Emission Source	CAS No.	Contaminant Name
U - CTG01		OIL	CTG01	0NY750 - 00 - 0	Carbon Dioxide Equivalents

Monitoring Information

☐ Continuous Emission Monitoring
☐ Intermittent Emission Testing
☐ Ambient Air Monitoring
☐ Monitoring of Process or Control Device Parameters as Surrogate
☐ Work Practice Involving Specific Operations
☒ **Record Keeping/Maintenance Procedures**

Description

The permittee shall maintain the combustion turbine to meet a BACT emission limit of 1,608 lb CO2e / MW-hr (gross basis) while firing ULSD. This emission limit is based on ISO conditions at 100% load without evaporative cooling. A demonstration that the turbine meets this emission limit will be made once during the term of the permit.

The lb/MW-hr rate is based on ISO conditions (59ºF, 14.7 psia, 60% humidity)

Work Practice Type	Process Material Code	Process Material Description	Reference Test Method

Parameter Code	Parameter Code	Manufacturer Name/Model No.

Limit Upper	Limit Lower	Limit Units Code	Limit Units Description
1,608		8	Pounds per megawatt hour

Averaging Method Code	Averaging Method Description	Monitoring Frequency Code	Monitoring Frequency Description	Reporting Requirements Code	Reporting Requirements Description
63	See monitoring description	17	Once per permit term	15	Annually (calendar)

Section IV - Emission Unit Information

Emission Unit Compliance Certification (continuation)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	NYCRR	201	6						

☒ **Applicable Federal Requirement** ☐ State Only Requirement ☐ Capping

Emission Unit	Emission Point	Process	Emission Source	CAS No.	Contaminant Name
U - CTG01		GAS	CTG01	0NY998 - 10 - 0	Volatile Organic Compounds

Monitoring Information

☐ Continuous Emission Monitoring
☒ **Intermittent Emission Testing**
☐ Ambient Air Monitoring
☐ Monitoring of Process or Control Device Parameters as Surrogate
☐ Work Practice Involving Specific Operations
☐ Record Keeping/Maintenance Procedures

Description

The permittee shall perform an initial stack test for volatile organic compounds to demonstrate compliance with an emission limit of 10.2 pounds per hour during steady-state operation when firing natural gas.

Work Practice Type	Process Material Code	Process Material Description	Reference Test Method
1			USEPA Method 18 or 25A

Parameter Code	Parameter Code	Manufacturer Name/Model No.

Limit Upper	Limit Lower	Limit Units Code	Limit Units Description
10.2		3	Pounds per hour

Averaging Method Code	Averaging Method Description	Monitoring Frequency Code	Monitoring Frequency Description	Reporting Requirements Code	Reporting Requirements Description
20	Per reference test method	13	Single Occurrence	01	Once per occurrence

DEC ID
2 - 6 3 0 1 - 0 0 1 9 1

Section IV - Emission Unit Information

Emission Unit Compliance Certification (continuation)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	NYCRR	201	6						

☒ **Applicable Federal Requirement** ☐ State Only Requirement ☐ Capping

Emission Unit	Emission Point	Process	Emission Source	CAS No.	Contaminant Name
U - CTG01		OIL	CTG01	0NY998 - 10 - 0	Volatile Organic Compounds

Monitoring Information

☐ Continuous Emission Monitoring
☒ **Intermittent Emission Testing**
☐ Ambient Air Monitoring
☐ Monitoring of Process or Control Device Parameters as Surrogate
☐ Work Practice Involving Specific Operations
☐ Record Keeping/Maintenance Procedures

Description

The permittee shall perform an initial stack test for volatile organic compounds to demonstrate compliance with an emission limit of 10.8 pounds per hour during steady-state operation when firing ULSD.

Work Practice Type	Process Material Code	Process Material Description	Reference Test Method
			USEPA Method 18 or 25A

Parameter Code	Parameter Code	Manufacturer Name/Model No.

Limit Upper	Limit Lower	Limit Units Code	Limit Units Description
10.8		3	Pounds per hour

Averaging Method Code	Averaging Method Description	Monitoring Frequency Code	Monitoring Frequency Description	Reporting Requirements Code	Reporting Requirements Description
20	Per reference test method	13	Single Occurrence	01	Once per occurrence

Section IV - Emission Unit Information

Emission Unit Compliance Certification (continuation)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	NYCRR	201	6						

☒ **Applicable Federal Requirement** ☐ State Only Requirement ☐ Capping

Emission Unit	Emission Point	Process	Emission Source	CAS No.	Contaminant Name
U - CTG01		GAS	CTG01	0NY210 - 00 - 0	Oxides of Nitrogen

Monitoring Information

☒ **Continuous Emission Monitoring**
☐ Intermittent Emission Testing
☐ Ambient Air Monitoring
☐ Monitoring of Process or Control Device Parameters as Surrogate
☐ Work Practice Involving Specific Operations
☐ Record Keeping/Maintenance Procedures

Description

The permittee shall install, calibrate, and maintain a continuous emissions monitoring system for nitrogen oxides (NOx), in accordance with the manufacturer's specifications. The concentration of NOx shall not exceed 2.5 ppmv (dry, corrected to 15% oxygen) during steady-state operation when firing natural gas.

Excess emissions will be reported in the quarterly excess emissions report.

Work Practice Type	Process Material Code	Process Material Description	Reference Test Method
			40 CFR 75

Parameter Code	Parameter Code	Manufacturer Name/Model No.
		TBD

Limit Upper	Limit Lower	Limit Units Code	Limit Units Description
2.5		275	Parts per million by volume, dry @ 15% O2

Averaging Method Code	Averaging Method Description	Monitoring Frequency Code	Monitoring Frequency Description	Reporting Requirements Code	Reporting Requirements Description
08	1-hour average	01	Continuous	13	Quarterly (Calendar)

Section IV - Emission Unit Information

Emission Unit Compliance Certification (continuation)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	NYCRR	201	6						

☒ **Applicable Federal Requirement** ☐ State Only Requirement ☐ Capping

Emission Unit	Emission Point	Process	Emission Source	CAS No.	Contaminant Name
U - CTG01		GAS	CTG01	0NY210 - 00 - 0	Oxides of Nitrogen

Monitoring Information

☒ **Continuous Emission Monitoring**
☐ Intermittent Emission Testing
☐ Ambient Air Monitoring
☐ Monitoring of Process or Control Device Parameters as Surrogate
☐ Work Practice Involving Specific Operations
☐ Record Keeping/Maintenance Procedures

Description

The permittee shall install, calibrate, and maintain a continuous emissions monitoring system for nitrogen oxides (NOx), in accordance with the manufacturer's specifications. The hourly mass emissions of NOx shall not exceed 36.5 pounds per hour during steady-state operation when firing natural gas.

Excess emissions will be reported in the quarterly excess emissions report.

Work Practice Type	Process Material Code	Process Material Description	Reference Test Method
			40 CFR 75

Parameter Code	Parameter Code	Manufacturer Name/Model No.
		TBD

Limit Upper	Limit Lower	Limit Units Code	Limit Units Description
36.5		3	Pounds per hour

Averaging Method Code	Averaging Method Description	Monitoring Frequency Code	Monitoring Frequency Description	Reporting Requirements Code	Reporting Requirements Description
08	1-hour average	01	Continuous	13	Quarterly (Calendar)

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Section IV - Emission Unit Information

Emission Unit Compliance Certification (continuation)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	NYCRR	201	6						

☒ **Applicable Federal Requirement** ☐ State Only Requirement ☐ Capping

Emission Unit	Emission Point	Process	Emission Source	CAS No.	Contaminant Name
U - CTG01		OIL	CTG01	0NY210 - 00 - 0	Oxides of Nitrogen

Monitoring Information

☒ **Continuous Emission Monitoring**
☐ Intermittent Emission Testing
☐ Ambient Air Monitoring
☐ Monitoring of Process or Control Device Parameters as Surrogate
☐ Work Practice Involving Specific Operations
☐ Record Keeping/Maintenance Procedures

Description

The permittee shall install, calibrate, and maintain a continuous emissions monitoring system for nitrogen oxides (NOx), in accordance with the manufacturer's specifications. The concentration of NOx shall not exceed 5 ppmv (dry, corrected to 15% oxygen) during steady-state operation when firing ULSD.

Excess emissions will be reported in the quarterly excess emissions report.

Work Practice Type	Process Material Code	Process Material Description	Reference Test Method
			40 CFR 75

Parameter Code	Parameter Code	Manufacturer Name/Model No.
		TBD

Limit Upper	Limit Lower	Limit Units Code	Limit Units Description
5		275	Parts per million by volume, dry @ 15% O2

Averaging Method Code	Averaging Method Description	Monitoring Frequency Code	Monitoring Frequency Description	Reporting Requirements Code	Reporting Requirements Description
08	1-hour average	01	Continuous	13	Quarterly (Calendar)

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Section IV - Emission Unit Information

Emission Unit Compliance Certification (continuation)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	**NYCRR**	**201**	**6**						

☒ **Applicable Federal Requirement** ☐ State Only Requirement ☐ Capping

Emission Unit	Emission Point	Process	Emission Source	CAS No.	Contaminant Name
U - CTG01		**OIL**	**CTG01**	**0NY210 - 00 - 0**	**Oxides of Nitrogen**

Monitoring Information

☒ **Continuous Emission Monitoring**	☐ Monitoring of Process or Control Device Parameters as Surrogate
☐ Intermittent Emission Testing	☐ Work Practice Involving Specific Operations
☐ Ambient Air Monitoring	☐ Record Keeping/Maintenance Procedures

Description

The permittee shall install, calibrate, and maintain a continuous emissions monitoring system for nitrogen oxides (NOx), in accordance with the manufacturer's specifications. The hourly mass emissions of NOx shall not exceed 77.6 pounds per hour during steady-state operation when firing ULSD.

Excess emissions will be reported in the quarterly excess emissions report.

Work Practice Type	Process Material Code	Process Material Description	Reference Test Method
			40 CFR 75

Parameter Code	Parameter Code	Manufacturer Name/Model No.
		TBD

Limit Upper	Limit Lower	Limit Units Code	Limit Units Description
77.6		**3**	**Pounds per hour**

Averaging Method Code	Averaging Method Description	Monitoring Frequency Code	Monitoring Frequency Description	Reporting Requirements Code	Reporting Requirements Description
08	**1-hour average**	**01**	**Continuous**	**13**	**Quarterly (Calendar)**

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Section IV - Emission Unit Information

Emission Unit Compliance Certification (continuation)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	NYCRR	201	6						

☒ **Applicable Federal Requirement** ☐ State Only Requirement ☐ Capping

Emission Unit	Emission Point	Process	Emission Source	CAS No.	Contaminant Name
U - CTG01		GAS	CTG01	000630 - 08 - 0	Carbon Monoxide

Monitoring Information

☒ **Continuous Emission Monitoring**
☐ Intermittent Emission Testing
☐ Ambient Air Monitoring
☐ Monitoring of Process or Control Device Parameters as Surrogate
☐ Work Practice Involving Specific Operations
☐ Record Keeping/Maintenance Procedures

Description

The permittee shall install, calibrate, and maintain a continuous emissions monitoring system for carbon monoxide (CO), in accordance with the manufacturer's specifications. The concentration of CO shall not exceed 3.5 ppmv (dry, corrected to 15% oxygen) during steady-state operation when firing natural gas.

Excess emissions will be reported in the quarterly excess emissions report.

Work Practice Type	Process Material Code	Process Material Description	Reference Test Method
			40 CFR 60, Appx B & F

Parameter Code	Parameter Code	Manufacturer Name/Model No.
		TBD

Limit Upper	Limit Lower	Limit Units Code	Limit Units Description
3.5		275	Parts per million by volume, dry @ 15% O2

Averaging Method Code	Averaging Method Description	Monitoring Frequency Code	Monitoring Frequency Description	Reporting Requirements Code	Reporting Requirements Description
08	1-hour average	01	Continuous	13	Quarterly (Calendar)

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Section IV - Emission Unit Information

Emission Unit Compliance Certification (continuation)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	NYCRR	201	6						

☒ **Applicable Federal Requirement** ☐ State Only Requirement ☐ Capping

Emission Unit	Emission Point	Process	Emission Source	CAS No.	Contaminant Name
U - CTG01		GAS	CTG01	000630 - 08 - 0	Carbon Monoxide

Monitoring Information

☒ **Continuous Emission Monitoring**
☐ Intermittent Emission Testing
☐ Ambient Air Monitoring
☐ Monitoring of Process or Control Device Parameters as Surrogate
☐ Work Practice Involving Specific Operations
☐ Record Keeping/Maintenance Procedures

Description

The permittee shall install, calibrate, and maintain a continuous emissions monitoring system for carbon monoxide (CO), in accordance with the manufacturer's specifications. The hourly mass emissions of CO shall not exceed 31.1 pounds per hour during steady-state operation when firing natural gas.

Excess emissions will be reported in the quarterly excess emissions report.

Work Practice Type	Process Material Code	Process Material Description	Reference Test Method
			40 CFR 60, Appx B & F

Parameter Code	Parameter Code	Manufacturer Name/Model No.
		TBD

Limit Upper	Limit Lower	Limit Units Code	Limit Units Description
31.1		3	Pounds per hour

Averaging Method Code	Averaging Method Description	Monitoring Frequency Code	Monitoring Frequency Description	Reporting Requirements Code	Reporting Requirements Description
08	1-hour average	01	Continuous	13	Quarterly (Calendar)

Section IV - Emission Unit Information

Emission Unit Compliance Certification (continuation)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	NYCRR	201	6						

☒ **Applicable Federal Requirement** ☐ State Only Requirement ☐ Capping

Emission Unit	Emission Point	Process	Emission Source	CAS No.	Contaminant Name
U - CTG01		OIL	CTG01	000630 - 08 - 0	Carbon Monoxide

Monitoring Information

☒ **Continuous Emission Monitoring**
☐ Intermittent Emission Testing
☐ Ambient Air Monitoring
☐ Monitoring of Process or Control Device Parameters as Surrogate
☐ Work Practice Involving Specific Operations
☐ Record Keeping/Maintenance Procedures

Description

The permittee shall install, calibrate, and maintain a continuous emissions monitoring system for carbon monoxide (CO), in accordance with the manufacturer's specifications. The concentration of CO shall not exceed 5 ppmv (dry, corrected to 15% oxygen) during steady-state operation when firing ULSD.

Excess emissions will be reported in the quarterly excess emissions report.

Work Practice Type	Process Material Code	Process Material Description	Reference Test Method
			40 CFR 60, Appx B & F

Parameter Code	Parameter Code	Manufacturer Name/Model No.
		TBD

Limit Upper	Limit Lower	Limit Units Code	Limit Units Description
5		275	Parts per million by volume, dry @ 15% O2

Averaging Method Code	Averaging Method Description	Monitoring Frequency Code	Monitoring Frequency Description	Reporting Requirements Code	Reporting Requirements Description
08	1-hour average	01	Continuous	13	Quarterly (Calendar)

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Section IV - Emission Unit Information

Emission Unit Compliance Certification (continuation)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	NYCRR	201	6						

☒ **Applicable Federal Requirement** ☐ State Only Requirement ☐ Capping

Emission Unit	Emission Point	Process	Emission Source	CAS No.	Contaminant Name
U - CTG01		OIL	CTG01	000630 - 08 - 0	Carbon Monoxide

Monitoring Information

☒ **Continuous Emission Monitoring**
☐ Intermittent Emission Testing
☐ Ambient Air Monitoring
☐ Monitoring of Process or Control Device Parameters as Surrogate
☐ Work Practice Involving Specific Operations
☐ Record Keeping/Maintenance Procedures

Description

The permittee shall install, calibrate, and maintain a continuous emissions monitoring system for carbon monoxide (CO), in accordance with the manufacturer's specifications. The hourly mass emissions of CO shall not exceed 47.2 pounds per hour during steady-state operation when firing ULSD.

Excess emissions will be reported in the quarterly excess emissions report.

Work Practice Type	Process Material Code	Process Material Description	Reference Test Method
			40 CFR 60, Appx B & F

Parameter Code	Parameter Code	Manufacturer Name/Model No.
		TBD

Limit Upper	Limit Lower	Limit Units Code	Limit Units Description
47.2		3	Pounds per hour

Averaging Method Code	Averaging Method Description	Monitoring Frequency Code	Monitoring Frequency Description	Reporting Requirements Code	Reporting Requirements Description
08	1-hour average	01	Continuous	13	Quarterly (Calendar)

Section IV - Emission Unit Information

Emission Unit Compliance Certification (continuation)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	NYCRR	201	6						

☒ **Applicable Federal Requirement** ☐ State Only Requirement ☐ Capping

Emission Unit	Emission Point	Process	Emission Source	CAS No.	Contaminant Name
U - CTG01			CTG01	7664 - 41 - 7	Ammonia

Monitoring Information

☒ **Continuous Emission Monitoring**
☐ Intermittent Emission Testing
☐ Ambient Air Monitoring
☐ Monitoring of Process or Control Device Parameters as Surrogate
☐ Work Practice Involving Specific Operations
☐ Record Keeping/Maintenance Procedures

Description

The permittee shall install, calibrate, and maintain a continuous emissions monitoring system for ammonia slip, in accordance with the manufacturer's specifications. The concentration of ammonia slip shall not exceed 5 ppmv (dry, corrected to 15% oxygen) during steady-state operation. This limit applies to the turbine firing natural gas or ULSD.

Excess emissions will be reported in the quarterly excess emissions report.

Work Practice Type	Process Material Code	Process Material Description	Reference Test Method
			40 CFR 60, Appx B & F

Parameter Code	Parameter Code	Manufacturer Name/Model No.
		TBD

Limit Upper	Limit Lower	Limit Units Code	Limit Units Description
5		275	Parts per million by volume, dry @ 15% O2

Averaging Method Code	Averaging Method Description	Monitoring Frequency Code	Monitoring Frequency Description	Reporting Requirements Code	Reporting Requirements Description
08	1-hour average	01	Continuous	13	Quarterly (Calendar)

DEC ID											
2	-	6	3	0	1	-	0	0	1	9	1

Section IV - Emission Unit Information

Emission Unit Compliance Certification (continuation)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	NYCRR	201	6						

☒ **Applicable Federal Requirement** ☐ State Only Requirement ☐ Capping

Emission Unit	Emission Point	Process	Emission Source	CAS No.	Contaminant Name
U - CTG01		SUG	CTG01	- -	
U - CTG01		SUO	CTG01		

Monitoring Information

☐ Continuous Emission Monitoring
☐ Intermittent Emission Testing
☐ Ambient Air Monitoring
☒ **Monitoring of Process or Control Device Parameters as Surrogate**
☐ Work Practice Involving Specific Operations
☐ Record Keeping/Maintenance Procedures

Description

Start-up is defined as not to exceed 30 minutes in duration, beginning from the point when the flame is initiated.

The facility shall record the date and time of each startup event.

Work Practice Type	Process Material Code	Process Material Description	Reference Test Method

Parameter Code	Parameter Code	Manufacturer Name/Model No.
	Duration of startup	

Limit Upper	Limit Lower	Limit Units Code	Limit Units Description
30			**Minutes**

Averaging Method Code	Averaging Method Description	Monitoring Frequency Code	Monitoring Frequency Description	Reporting Requirements Code	Reporting Requirements Description
60	**Maximum, not to exceed**	**01**	**Continuous**	**13**	**Quarterly (Calendar)**

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Section IV - Emission Unit Information

Emission Unit Compliance Certification (continuation)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	NYCRR	201	6						

☒ **Applicable Federal Requirement** ☐ State Only Requirement ☐ Capping

Emission Unit	Emission Point	Process	Emission Source	CAS No.	Contaminant Name
U - CTG01		SDG	CTG01	- -	
U - CTG01		SDO	CTG01		

Monitoring Information

☐ Continuous Emission Monitoring
☐ Intermittent Emission Testing
☐ Ambient Air Monitoring
☒ **Monitoring of Process or Control Device Parameters as Surrogate**
☐ Work Practice Involving Specific Operations
☐ Record Keeping/Maintenance Procedures

Description

Shutdown is defined as commencing with sending the stop signal to the controller and ending with the cessation of fuel firing in the turbine, not to exceed 20 minutes in duration.

The facility shall record the date and time of each shutdown event.

Work Practice Type	Process Material Code	Process Material Description	Reference Test Method

Parameter Code	Parameter Description	Manufacturer Name/Model No.
	Duration of shutdown	

Limit Upper	Limit Lower	Limit Units Code	Limit Units Description
20			**Minutes**

Averaging Method Code	Averaging Method Description	Monitoring Frequency Code	Monitoring Frequency Description	Reporting Requirements Code	Reporting Requirements Description
60	Maximum, not to exceed	01	Continuous	13	Quarterly (Calendar)

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Section IV - Emission Unit Information

Emission Unit Compliance Certification (continuation)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	NYCRR	201	6						

☒ **Applicable Federal Requirement** ☐ State Only Requirement ☐ Capping

Emission Unit	Emission Point	Process	Emission Source	CAS No.	Contaminant Name
U - CTG01		SUG	CTG01		
U - CTG01		SDG	CTG01		
U - CTG01		SUO	CTG01		
U - CTG01		SDO	CTG01		

Monitoring Information

☐ Continuous Emission Monitoring
☐ Intermittent Emission Testing
☐ Ambient Air Monitoring
☐ Monitoring of Process or Control Device Parameters as Surrogate
☐ Work Practice Involving Specific Operations
☒ **Record Keeping/Maintenance Procedures**

Description

Within 18 months of the commencement of operation of CTG01, the facility shall collect and submit to the Department data for at least 15 start-up and 15 shutdown events when firing each fuel (natural gas and ULSD) in the combustion turbine.

If deemed necessary by the Department after reviewing the submitted data, the permittee shall submit a permit modification to establish enforceable combustion turbine start-up and shutdown emission rates for CO, NOx, and ammonia and, if requested by the Department, confirm that such established rates will not result in a violation of applicable national ambient air quality standards(NAAQS).

Work Practice Type	Process Material Code	Process Material Description	Reference Test Method

Parameter Code	Parameter Code	Manufacturer Name/Model No.

Limit Upper	Limit Lower	Limit Units Code	Limit Units Description

Averaging Method Code	Averaging Method Description	Monitoring Frequency Code	Monitoring Frequency Description	Reporting Requirements Code	Reporting Requirements Description
		14	As required, see monitoring description	16	As required, see monitoring description

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Section IV - Emission Unit Information

Emission Unit Compliance Certification (continuation)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	NYCRR	231	8	6					

☒ **Applicable Federal Requirement** ☐ State Only Requirement ☐ Capping

Emission Unit	Emission Point	Process	Emission Source	CAS No.	Contaminant Name
U - CTG01		OIL	CTG01		
U - CTG01		SUO	CTG01		
U - CTG01		SDO	CTG01		

Monitoring Information

☐ Continuous Emission Monitoring
☐ Intermittent Emission Testing
☐ Ambient Air Monitoring
☐ Monitoring of Process or Control Device Parameters as Surrogate
☐ Work Practice Involving Specific Operations
☒ **Record Keeping/Maintenance Procedures**

Description

The facility shall limit ULSD firing in the CTG01 to 21.954 million gallons per rolling 12-month period under all modes of operation on ULSD (steady-state, start-up and shutdown, and fuel switching).

Records will be maintained of monthly and rolling 12-month ULSD usage and a summary report will be included with the semi-annual monitoring report.

Work Practice Type	Process Material Code	Process Material Description	Reference Test Method

Parameter Code	Parameter Code	Manufacturer Name/Model No.

Limit Upper	Limit Lower	Limit Units Code	Limit Units Description
21,954,000		18	Gallons per year

Averaging Method Code	Averaging Method Description	Monitoring Frequency Code	Monitoring Frequency Description	Reporting Requirements Code	Reporting Requirements Description
17	Annual max rolled monthly	05	Monthly	14	Semi-Annually (Calendar)

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Section IV - Emission Unit Information

Emission Unit Compliance Certification (continuation)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause

☒ **Applicable Federal Requirement** ☐ State Only Requirement ☐ Capping

Emission Unit	Emission Point	Process	Emission Source	CAS No.	Contaminant Name
A - 00005		**BLK**		**0N210 - 00 - 0**	**Oxides of Nitrogen**

Monitoring Information

☐ Continuous Emission Monitoring
☐ Intermittent Emission Testing
☐ Ambient Air Monitoring
☐ Monitoring of Process or Control Device Parameters as Surrogate
☐ Work Practice Involving Specific Operations
☒ **Record Keeping/Maintenance Procedures**

Description

After beginning operation of Emission Unit CTG01, the permittee shall limit NOx emissions from emission units 41A and 42B to 2.99 tons on a rolling 12-month basis.

Emissions will be calculated on a monthly basis using fuel records, engine operating times, and emission factors.

Work Practice Type	Process Material Code	Process Material Description	Reference Test Method

Parameter Code	Parameter Code	Manufacturer Name/Model No.

Limit Upper	Limit Lower	Limit Units Code	Limit Units Description
2.99		**38**	**Tons per year**

Averaging Method Code	Averaging Method Description	Monitoring Frequency Code	Monitoring Frequency Description	Reporting Requirements Code	Reporting Requirements Description
17	**Annual max, rolled monthly**	**05**	**Monthly**	**14**	**Semi-Annual (Calendar)**

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Determination of Non-Applicability (Title V Applications Only)

☐Continuation Sheet(s)

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause
6	NYCRR	231	6	1					

Emission Unit	Emission Point	Process	Emission Source	
-				☒**Applicable Federal Requirement** ☐State Only Requirement

Non-Applicability Description

The facility is replacing 22 of the existing Pratt & Whitney simple cycle combustion turbines with a newer, larger, and more efficient simple cycle combustion turbine. The facility is using the reductions from the shutdown and curtailment of the existing Pratt & Whitney combustion turbines to net out of Part 231-6 nonattainment applicability for NOx and VOC. Therefore, the project will not be subject to the requirements of nonattainment new source review under Part 231-6

Rule Citation

Title	Type	Part	Sub Part	Section	Sub Division	Paragraph	Sub Paragraph	Clause	Sub Clause

Emission Unit	Emission Point	Process	Emission Source	
-				☐Applicable Federal Requirement ☐ State Only Requirement

Non-Applicability Description

Compliance Plan

Continuation Sheet(s)

For any emission units which are not in compliance at the time of permit application, the applicant shall complete the following:

Consent Order		Certified progress reports are to be submitted every 6 months beginning / /

Emission Unit	Process	Emission Source	Applicable Federal Requirement									
			Title	Type	Part	Subpart	Section	Subdiv.	Parag.	Subparag.	Clause	Subcl.

Remedial Measures and Intermediate Milestones	R/I	Date Scheduled

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Request for Emission Reduction Credits

☒ Continuation Sheet(s)

Emission Source: G T 2 1 A

Emission Reduction Description

Future shutdown of emission sources, 22 existing Pratt & Whitney combustion turbines. Curtailment of operations of 2 existing Pratt & Whitney combustion turbines to 12 hours per year per turbine.

Contaminant Emission Reduction Data

Baseline Period **May / 1 / 2015** to **April / 30 / 2017**

Reduction Date	Reduction Method
June / 1 / 2023	**01**

CAS Number	Contaminant Name	ERC (lbs/yr) Netting	ERC (lbs/yr) Offset
0NY210 - 00 - 0	**Oxides of Nitrogen**	**9,423**	
0NY998 - 10 - 0	**Volatile Organic Compounds**	**51**	
- -			
- -			

Facility to Use Future Reduction

Name	**Astoria Gas Turbine Power LLC**	Application ID	**2 - 6 3 0 1 - 0 0 1 9 1 / 0 0 0 0 3**
Location Address	**31-01 20th Avenue**		
☐ City / ☐ Town / ☐ Village **Astoria**	State **NY**	Zip **11105**	

Use of Emission Reduction Credits

☒ Continuation Sheet(s)

Emission Source: C T G 0 1

Proposed Project Description

Construction of General Electric H-Class combustion turbine model 7HA.03, emergency diesel generator, two diesel fire pumps.

Contaminant Emissions Increase Data

CAS No.	Contaminant Name	PEP (lbs/yr)
0NY210 - 00 - 0	**Oxides of Nitrogen**	**194,905**

Statement of Compliance

☒ All facilities under the ownership of this "ownership/firm" are operating in compliance with all applicable requirements and state regulations including any compliance certification requirements under Section 114(a)(3) of the Clean Air Act Amendments of 1990, or are meeting the schedule of a consent order.

Source of Emission Reduction Credit – Facility

Name	**Astoria Gas Turbine Power**	Permit ID	**2 - 6 3 0 1 - 0 0 1 9 1 / 0 0 0 0 3**
Location Address	**31-01 20th Avenue**		
☐ City / ☐ Town / ☐ Village **Astoria**	State **NY**	Zip **11105**	

Emission Source	CAS Number	Contaminant Name	ERC (lbs/yr) Netting	ERC (lbs/yr) Offset
GT24A	**0NY210 - 00 - 0**	**Oxides of Nitrogen**	**10,673**	
GT24B	**0NY210 00 0**	**Oxides of Nitrogen**	**10,674**	
GT31A	**0NY210 - 00 - 0**	**Oxides of Nitrogen**	**10,564**	
GT32B	**0NY210 - 00 - 0**	**Oxides of Nitrogen**	**10,941**	

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Section IV - Emission Unit Information

Request for Emission Reduction Credits (continuation)

Emission Reduction Description

Future shutdown of emission sources, 22 existing Pratt & Whitney combustion turbines.

Contaminant Emission Reduction Data

Baseline Period	May / 1 / 2015 to April / 30 / 2017	Reduction Date	June/ 1 / 2023

Contaminant Emission Reduction Data

Emission Source	Reduction Method	CAS Number	Contaminant Name	ERC (lbs/yr) Netting	ERC (lbs/yr) Offset
GT21B	01	0NY210 - 00 - 0	Oxides of Nitrogen	9,438	
GT21B	01	0NY998 - 10 - 0	Volatile Organic Compounds	51	
GT22A	01	0NY210 - 00 - 0	Oxides of Nitrogen	12,274	
GT22A	01	0NY998 - 10 - 0	Volatile Organic Compounds	68	
GT22B	01	0NY210 - 00 - 0	Oxides of Nitrogen	12,263	
GT22B	01	0NY998 - 10 - 0	Volatile Organic Compounds	68	
GT23A	01	0NY210 - 00 - 0	Oxides of Nitrogen	6,784	
GT23A	01	0NY998 - 10 - 0	Volatile Organic Compounds	39	
GT23B	01	0NY210 - 00 - 0	Oxides of Nitrogen	6,787	
GT23B	01	0NY998 - 10 - 0	Volatile Organic Compounds	39	
GT24A	01	0NY210 - 00 - 0	Oxides of Nitrogen	10,673	
GT24A	01	0NY998 - 10 - 0	Volatile Organic Compounds	60	
GT24B	01	0NY210 - 00 - 0	Oxides of Nitrogen	10,674	
GT24B	01	0NY998 - 10 - 0	Volatile Organic Compounds	60	
GT31A	01	0NY210 - 00 - 0	Oxides of Nitrogen	10,564	
GT31A	01	0NY998 - 10 - 0	Volatile Organic Compounds	59	
GT31B	01	0NY210 - 00 - 0	Oxides of Nitrogen	10,446	
GT31B	01	0NY998 - 10 - 0	Volatile Organic Compounds	58	
GT32A	01	0NY210 - 00 - 0	Oxides of Nitrogen	10,941	
GT32A	01	0NY998 - 10 - 0	Volatile Organic Compounds	62	
GT32B	01	0NY210 - 00 - 0	Oxides of Nitrogen	10,941	
GT32B	01	0NY998 - 10 - 0	Volatile Organic Compounds	62	
GT33A	01	0NY210 - 00 - 0	Oxides of Nitrogen	8,887	
GT33A	01	0NY998 - 10 - 0	Volatile Organic Compounds	50	
GT33B	01	0NY210 - 00 - 0	Oxides of Nitrogen	8,887	
GT33B	01	0NY998 - 10 - 0	Volatile Organic Compounds	50	
GT34A	01	0NY210 - 00 - 0	Oxides of Nitrogen	9,129	
GT34A	01	0NY998 - 10 - 0	Volatile Organic Compounds	50	
GT34B	01	0NY210 - 00 - 0	Oxides of Nitrogen	9,129	
GT34B	01	0NY998 - 10 - 0	Volatile Organic Compounds	50	
GT41A	01	0NY210 - 00 - 0	Oxides of Nitrogen	9,901	
GT41A	01	0NY998 - 10 - 0	Volatile Organic Compounds	72	
GT41B	01	0NY210 - 00 - 0	Oxides of Nitrogen	12,821	
GT41B	01	0NY998 - 10 - 0	Volatile Organic Compounds	71	

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Section IV - Emission Unit Information

Request for Emission Reduction Credits (continuation)

Emission Reduction Description

Future shutdown of emission sources, 22 existing Pratt & Whitney combustion turbines.

Contaminant Emission Reduction Data

Baseline Period	Reduction Date
May / 1 / 2015 to **April / 30 / 2017**	**June/ 1 / 2023**

Contaminant Emission Reduction Data

Emission Source	Reduction Method	CAS Number					Contaminant Name	ERC (lbs/yr) Netting	ERC (lbs/yr) Offset
GT42A	01	0NY210	-	00	-	0	Oxides of Nitrogen	12,908	
GT42A	01	0NY998	-	10	-	0	Volatile Organic Compounds	72	
GT42B	01	0NY210	-	00	-	0	Oxides of Nitrogen	12,843	
GT42B	01	0NY998	-	10	-	0	Volatile Organic Compounds	72	
GT43A	01	0NY210	-	00	-	0	Oxides of Nitrogen	13,044	
GT43A	01	0NY998	-	10	-	0	Volatile Organic Compounds	74	
GT43B	01	0NY210	-	00	-	0	Oxides of Nitrogen	13,044	
GT43B	01	0NY998	-	10	-	0	Volatile Organic Compounds	74	
GT44A	01	0NY210	-	00	-	0	Oxides of Nitrogen	11,635	
GT44A	01	0NY998	-	10	-	0	Volatile Organic Compounds	66	
GT44B	01	0NY210	-	00	-	0	Oxides of Nitrogen	11,635	
GT44B	01	0NY998	-	10	-	0	Volatile Organic Compounds	66	

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Section IV - Emission Unit Information

Use of Emission Reduction Credits (continuation)

Emission Source: CTG01

Proposed Project Description

Construction of General Electric H-Class combustion turbine model 7HA.03, emergency diesel generator, two diesel fire pumps.

Contaminant Emissions Increase Data

CAS No.	Contaminant Name	PEP (lbs/yr)
0NY210 - 00 - 0	Oxides of Nitrogen	194,905

Source of Emission Reduction Credit – Facility

Name	Astoria Gas Turbine Power	Permit ID	2-6301-00191/00003
Location Address	31-01 20th Avenue		
☐ City / ☐ Town / ☐ Village	Astoria	State: NY	Zip: 11105

Emission Source	CAS Number	Contaminant Name	ERC (lbs/yr) Netting	ERC (lbs/yr) Offset
GT33A	0NY210 - 00 - 0	Oxides of Nitrogen	8,887	
GT34A	0NY210 - 00 - 0	Oxides of Nitrogen	9,129	
GT34B	0NY210 - 00 - 0	Oxides of Nitrogen	9,129	
GT42A	0NY210 - 00 - 0	Oxides of Nitrogen	12,908	
GT42B	0NY210 - 00 - 0	Oxides of Nitrogen	12,843	
GT43A	0NY210 - 00 - 0	Oxides of Nitrogen	13,044	
GT43B	0NY210 - 00 - 0	Oxides of Nitrogen	13,044	
GT44B	0NY210 - 00 - 0	Oxides of Nitrogen	11,635	
GT44B	0NY210 - 00 - 0	Oxides of Nitrogen	11,635	

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Use of Emission Reduction Credits (continuation)

Emission Source: CTG01

Proposed Project Description

Construction of General Electric H-Class combustion turbine model 7HA.03, emergency diesel generator, two diesel fire pumps.

Contaminant Emissions Increase Data

CAS No.	Contaminant Name	PEP (lbs/yr)
0NY998 - 00 - 0	Volatile Organic Compounds	50,800

Source of Emission Reduction Credit – Facility

Name	Astoria Gas Turbine Power	Permit ID: 2-6301-00191/00003
Location Address	31-01 20th Avenue	
☐ City / ☐ Town / ☐ Village	Astoria	State: NY / Zip: 11105

Emission Source	CAS Number	Contaminant Name	ERC (lbs/yr) Netting	ERC (lbs/yr) Offset
GT21A	0NY998 - 10 - 0	Volatile Organic Compounds	51	
GT21B	0NY998 - 10 - 0	Volatile Organic Compounds	51	
GT22A	0NY998 - 10 - 0	Volatile Organic Compounds	68	
GT22B	0NY998 - 10 - 0	Volatile Organic Compounds	68	
GT23A	0NY998 - 10 - 0	Volatile Organic Compounds	39	
GT23B	0NY998 10 0	Volatile Organic Compounds	39	
GT42B	0NY998 - 10 - 0	Volatile Organic Compounds	60	
GT32A	0NY998 - 10 - 0	Volatile Organic Compounds	62	
GT32B	0NY998 - 10 - 0	Volatile Organic Compounds	62	
GT33B	0NY998 - 10 - 0	Volatile Organic Compounds	50	
GT34A	0NY998 - 10 - 0	Volatile Organic Compounds	50	
GT34B	0NY998 - 10 - 0	Volatile Organic Compounds	50	
GT42A	0NY998 - 10 - 0	Volatile Organic Compounds	72	
GT42B	0NY998 - 10 - 0	Volatile Organic Compounds	72	
GT43B	0NY998 - 10 - 0	Volatile Organic Compounds	74	
GT44A	0NY998 - 10 - 0	Volatile Organic Compounds	66	
GT44B	0NY998 - 10 - 0	Volatile Organic Compounds	66	

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Supporting Documentation and Attachments	
Required Supporting Documentation	Date of Document
☒ **List of Exempt Activities (attach form)**	
☒ **Plot Plan (See Appendix B)**	
☒ **Process Flow Diagram**	
☒ **Methods Used to Determine Compliance (attach form)**	
☒ **Emissions Calculations (See Appendix C)**	
Optional Supporting Documentation	Date of Document
☒ **Air Quality Model (See Document Section 5 and Appendix E)**	
☐ Confidentiality Justification	
☐ Ambient Air Quality Monitoring Plan or Reports	
☐ Stack Test Protocol	
☐ Stack Test Report	
☐ Continuous Emissions Monitoring Plan	
☐ Lowest Achievable Emission Rate (LAER) Demonstration	
☒ **Best Available Control Technology (BACT) Demonstration (see Document Section 4)**	
☐ Reasonably Available Control Technology (RACT) Demonstration	
☐ Toxic Impact Assessment (TIA)	
☐ Environmental Rating Demonstration	
☐ Operational Flexibility Protocol/Description of Alternate Operating Scenarios	
☒ **Title IV Permit Application**	
☒ **Emission Reduction Credit (ERC) Quantification (attach form)**	
☒ **Baseline Period Demonstration**	
☒ **Use of Emission Reduction Credits (attach form)**	
☒ **Analysis of Contemporaneous Emissions Increase/Decrease (see Document Section 3.1.2)**	
Other Supporting Documentation	Date of Document

Attachment A-1

Exempt Activities

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List of Exempt Activities

Instructions
Applicants for Title V facility permits must provide a listing of each exempt activity, as described in 6 NYCRR Part 201-3.2(c), that is currently operated at the facility. This form provides a means to fulfill this requirement. In order to complete this form, enter the number and building location of each exempt activity. Building IDs used on this form should match those used in the Title V permit application. If a listed activity is not operated at the facility, leave the corresponding information blank.

Combustion

Rule Citation 201-3.2(c)	Description	Number of Activities	Building Location
(1)	Stationary or portable combustion installations where the furnace has a maximum heat input capacity less than 10 mmBtu/hr burning fuels other than coal or wood; or a maximum heat input capacity of less than 1 mmBtu/hr burning coal or wood. This activity does not include combustion installations burning any material classified as solid waste, as defined in 6 NYCRR Part 360, or waste oil, as defined in 6 NYCRR Subpart 225-2.		
(2)	Space heaters burning waste oil at automotive service facilities, as defined in 6 NYCRR Subpart 225-2, generated on-site or at a facility under common control, alone or in conjunction with used oil generated by a do-it-yourself oil changer as defined in 6 NYCRR Subpart 374-2.		
(3)(i)	Stationary or portable internal combustion engines that are liquid or gaseous fuel powered and located within the New York City metropolitan area or the Orange County towns of Blooming Grove, Chester, Highlands, Monroe, Tuxedo, Warwick, or Woodbury, and have a maximum mechanical power rating of less than 200 brake horsepower.		
(3)(ii)	Stationary or portable internal combustion engines that are liquid or gaseous fuel powered and located outside of the New York City metropolitan area or the Orange County towns of Blooming Grove, Chester, Highlands, Monroe, Tuxedo, Warwick, or Woodbury, and have a maximum mechanical power rating of less than 400 brake horsepower.		
(3)(iii)	Stationary or portable internal combustion engines that are gasoline powered and have a maximum mechanical power rating of less than 50 brake horsepower.		
(4)	Reserved.		
(5)	Gas turbines with a heat input at peak load less then 10 mmBtu/hour		

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Rule Citation 201-3.2(c)	Description	Number of Activities	Building Location
(6)	Emergency power generating stationary internal combustion engines, as defined in 6 NYCRR Part 200.1(cq), and engine test cells at engine manufacturing facilities that are utilized for research and development, reliability performance testing, or quality assurance performance testing. Stationary internal combustion engines used for peak shaving and/or demand response programs are not exempt.		
Combustion Related			
(7)	Non-contact water cooling towers and water treatment systems for process cooling water and other water containers designed to cool, store or otherwise handle water that has not been in direct contact with gaseous or liquid process streams.	1	CTG Bld
Agricultural			
(8)	Feed and grain milling, cleaning, conveying, drying and storage operations including grain storage silos, where such silos exhaust to an appropriate emissions control device, excluding grain terminal elevators with permanent storage capacities over 2.5 million U.S. bushels, and grain storage elevators with capacities above one million bushels.		
(9)	Equipment used exclusively to slaughter animals, but not including other equipment at slaughterhouses, such as rendering cookers, boilers, heating plants, incinerators, and electrical power generating equipment.		
Commercial - Food Service Industries			
(10)	Flour silos at bakeries, provided all such silos are exhausted through an appropriate emission control device.		
(11)	Emissions from flavorings added to a food product where such flavors are manually added to the product.		
Commercial - Graphic Arts			
(12)	Screen printing inks/coatings or adhesives which are applied by a hand-held squeegee. A hand-held squeegee is one that is not propelled though the use of mechanical conveyance and is not an integral part of the screen printing process.		
(13)	Graphic arts processes at facilities located outside the New York City metropolitan area or the Orange County towns of Blooming Grove, Chester, Highlands, Monroe, Tuxedo, Warwick, or Woodbury whose facility-wide total emissions of volatile organic compounds from inks, coatings, adhesives, fountain solutions and cleaning solutions are less than three tons during any 12-month period.		

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Rule Citation 201-3.2(c)	Description	Number of Activities	Building Location
(14)	Graphic label and/or box labeling operations where the inks are applied by stamping or rolling.		
(15)	Graphic arts processes which are specifically exempted from regulation under 6 NYCRR Part 234, with respect to emissions of volatile organic compounds which are not given an A rating as described in 6 NYCRR Part 212.		
Commercial - Other			
(16)	Gasoline dispensing sites registered with the department pursuant to 6 NYCRR Part 612.		
(17)	Surface coating and related activities at facilities which use less than 25 gallons per month of total coating materials, or with actual volatile organic compound emissions of 1,000 pounds or less from coating materials in any 12-month period. Coating materials include all paints and paint components, other materials mixed with paints prior to application, and cleaning solvents, combined. This exemption is subject to the following: (i) The facility is located outside of the New York City metropolitan area or the Orange County towns of Blooming Grove, Chester, Highlands, Monroe, Tuxedo, Warwick, or Woodbury; and (ii) All abrasive cleaning and surface coating operations are performed in an enclosed building where such operations are exhausted into appropriate emission control devices.		
(18)	Abrasive cleaning operations which exhaust to an appropriate emission control device.		
(19)	Ultraviolet curing operations.		
Municipal/Public Health Related			
(20)	Landfill gas ventilating systems at landfills with design capacities less than 2.5 million megagrams (3.3 million tons) and 2.5 million cubic meters (2.75 million cubic yards), where the systems are vented directly to the atmosphere, and the ventilating system has been required by, and is operating under, the conditions of a valid 6 NYCRR Part 360 permit, or order on consent.		
Storage Vessels			
(21)	Distillate fuel oil, residual fuel oil, and liquid asphalt storage tanks with storage capacities below 300,000 barrels.	2	Outside

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Rule Citation 201-3.2(c)	Description	Number of Activities	Building Location
(22)	Pressurized fixed roof tanks which are capable of maintaining a working pressure at all times to prevent emissions of volatile organic compounds to the outdoor atmosphere.		
(23)	External floating roof tanks which are of welded construction and are equipped with a metallic-type shoe primary seal and a secondary seal from the top of the shoe seal to the tank wall.		
(24)	External floating roof tanks which are used for the storage of a petroleum or volatile organic liquid with a true vapor pressure less than 4.0 psi (27.6 kPa), are of welded construction and are equipped with one of the following: (i) a metallic-type shoe seal; (ii) a liquid-mounted foam seal; (iii) a liquid-mounted liquid-filled type seal; or (iv) equivalent control equipment or device.		
(25)	Storage tanks, including petroleum liquid storage tanks as defined in 6 NYCRR Part 229, with capacities less than 10,000 gallons, except those subject to 6 NYCRR Part 229 or Part 233.		
(26)	Horizontal petroleum or volatile organic liquid storage tanks.	1	Outside
(27)	Storage silos storing solid materials, provided all such silos are exhausted through an appropriate emission control device. This exemption does not include raw material, clinker, or finished product storage silos at Portland cement plants.		
Industrial			
(28)	Processing equipment at existing sand and gravel and stone crushing plants which were installed or constructed before August 31, 1983, where water is used for operations such as wet conveying, separating, and washing. This exemption does not include processing equipment at existing sand and gravel and stone crushing plants where water is used for dust suppression.		
(29)(i)	Sand and gravel processing or crushed stone processing lines at a non-metallic mineral processing facility that are a permanent or fixed installation with a maximum rated processing capacity of 25 tons of minerals per hour or less.		

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Rule Citation 201-3.2(c)	Description	Number of Activities	Building Location
(29)(ii)	Sand and gravel processing or crushed stone processing lines at a non-metallic mineral processing facility that are a portable emission source with a maximum rated processing capacity of 150 tons of minerals per hour or less.		
(29)(iii)	Sand and gravel processing or crushed stone processing lines at a non-metallic mineral processing facility that are used exclusively to screen minerals at a facility where no crushing or grinding takes place.		
(30)	Reserved.		
(31)	Surface coating operations which are specifically exempted from regulation under 6 NYCRR Part 228, with respect to emissions of volatile organic compounds which are not given an A rating pursuant to 6 NYCRR Part 212.		
(32)	Pharmaceutical tablet branding operations.		
(33)	Thermal packaging operations, including, but not limited to, therimage labeling, blister packing, shrink wrapping, shrink banding, and carton gluing.		
(34)	Powder coating operations.		
(35)	All tumblers used for the cleaning and/or deburring of metal products without abrasive blasting.		
(36)	Presses used exclusively for molding or extruding plastics except where halogenated carbon compounds or hydrocarbon solvents are used as foaming agents.		
(37)	Concrete batch plants where the cement weigh hopper and all bulk storage silos are exhausted through fabric filters, and the batch drop point is controlled by a shroud or other emission control device.		
(38)	Cement storage operations not located at Portland cement plants where materials are transported by screw or bucket conveyors.		
(39)(i)	Cold cleaning degreasers with an open surface area of 11 square feet or less and an internal volume of 93 gallons or less or, having an organic solvent loss of 3 gallons per day or less.		
39(ii)	Cold cleaning degreasers that use a solvent with a VOC content or five percent or less by weight, unless subject to the requirements of 40 CFR 63 Subpart T.		

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Rule Citation 201-3.2(c)	Description	Number of Activities	Building Location
(39)(iii)	Conveyorized degreasers with an air/vapor interface smaller than 22 square feet (2 square meters), unless subject to the requirements of 40 CFR 63 Subpart T.		
(39)(iv)	Open-top vapor degreasers with an open-top area smaller than 11 square feet (1 square meter), unless subject to the requirements of 40 CFR 63 Subpart T.		
Miscellaneous			
(40)	Ventilating and exhaust systems for laboratory operations. Laboratory operations do not include processes having a primary purpose to produce commercial quantities of materials.		
(41)	Exhaust or ventilating systems for the melting of gold, silver, platinum and other precious metals.		
(42)	Exhaust systems for paint mixing, transfer, filling or sampling and/or paint storage rooms or cabinets, provided the paints stored within these locations are stored in closed containers when not in use.		
(43)	Exhaust systems for solvent transfer, filling or sampling, and/or solvent storage rooms provided the solvent stored within these locations are stored in containers when not in use.		
(44)	Research and development activities, including both stand-alone and activities within a major facility, until such time as the administrator completes a rule making to determine how the permitting program should be structured for these activities.		
(45)	The application of odor counteractants and/or neutralizers.		
(46)	Hydrogen fuel cells.		
(47)	Dry cleaning equipment that uses only water-based cleaning processes or those using liquid carbon dioxide.		
(48)	Manure spreading, handling and storage at farms and agricultural facilities.		

Attachment A-2

Methods Used to Determine Compliance

DEC ID
2-6301-00191

METHODS USED TO DETERMINE COMPLIANCE

Emission Unit ID	Applicable Requirement	Method Used to Determine Compliance and Corresponding Date
Facility	6 NYCRR 211.2 6 NYCRR 227-1.3	Record keeping / maintenance procedure: Opacity observations viewed for abnormal conditions when a unit is operating.
Facility	6 NYCRR 225-1.2(h)	Record keeping / maintenance procedure: Record fuel oil analysis data, quantity received, and quantity burned
Facility	40 CFR 72 40 CFR 97.406 40 CFR 97.606 40 CFR 97.806	Record keeping / maintenance procedure: the facility complies with the relevant requirements for submitting NOx and SO2 information to EPA via the ECMPS data submission process on a quarterly basis.
Facility	6 NYCRR 201-6.4(c)(3)(ii)	Record keeping / maintenance procedure: Semi-annual monitoring reports are submitted every six months.
Facility	6 NYCRR 201-6.4(e)	Record keeping / maintenance procedure: Annual compliance reports are submitted to DEC within 30 days of the end of the period
Facility	6 NYCRR 202-2.1	Record keeping / maintenance procedure: Annual emissions statements are submitted to DEC by April 15th
Facility	6 NYCRR 202-2.5	Record keeping / maintenance procedure: Records are maintained for a period of 5 years
Facility	6 NYCRR 227-2.5(b)	Record keeping / maintenance procedure: The facility will comply with the existing NOx RACT system averaging plan.
Facility	6 NYCRR 227-3	The new turbine will meet the emission limit using a CEMS. 22 of the existing P&W turbines will be shutdown and 2 will remain as black start units.
Facility	6 NYCRR 201-6	Record keeping / maintenance procedure: The facility will maintain records of facility operations for tracking VOC and NOx emissions to maintain the respective annual ton/yr emission limits and will submit to the department semi-annually.
Facility	6 NYCRR 231-8.6	Record keeping / maintenance procedure: The facility will maintain records of facility operations for tracking PM-10, PM-2.5, and CO2e emissions to maintain the respective annual ton/yr emission limits and will submit to the department semi-annually.
Facility	6 NYCRR 231-11.2(c)	Record keeping / maintenance procedure: The facility will maintain records of facility operations for tracking CO and H2SO4 emissions and submit to the department annually.
U-CTG01	40 CFR 60 Subpart TTTT	Continuous emission monitoring: The new turbine will comply with the relevant emission limitation using a CO2 CEMS.
E-GENS	40 CFR 60 Subpart IIII 40 CFR 63 Subpart ZZZZ	The facility will purchase engines which are in compliance with the relevant emissions standards.
A-00005	6 NYCRR 200.6	Record keeping / maintenance procedure: The facility will limit the ULSD operation of each existing P&W turbine to no more than 14 hours per day and less than 1,930 hours per year. A log of turbine use is maintained.
A-00005	6 NYCRR 227.2(b)(1)	Intermittent Emission Testing: The turbines shall undergo stack testing for particulates once during the term of the permit.
A-00005	6 NYCRR 231-8.7	Record keeping / maintenance procedure: The two existing P&W turbines to be kept as black start units will be limited to 12 hours per year per turbine for all operations. A log of turbine use will be maintained.
U-CTG01	6 NYCRR 251.3(a)	Continuous emission monitoring: The new turbine will comply with the relevant emission limitation using a CO2 CEMS.
U-CTG01	6 NYCRR 251.3(b)	Monitoring of process or control device parameters as surrogate: The existing P&W turbines will comply with the relevant emission limitation using Part 75 emission calculation methodology.

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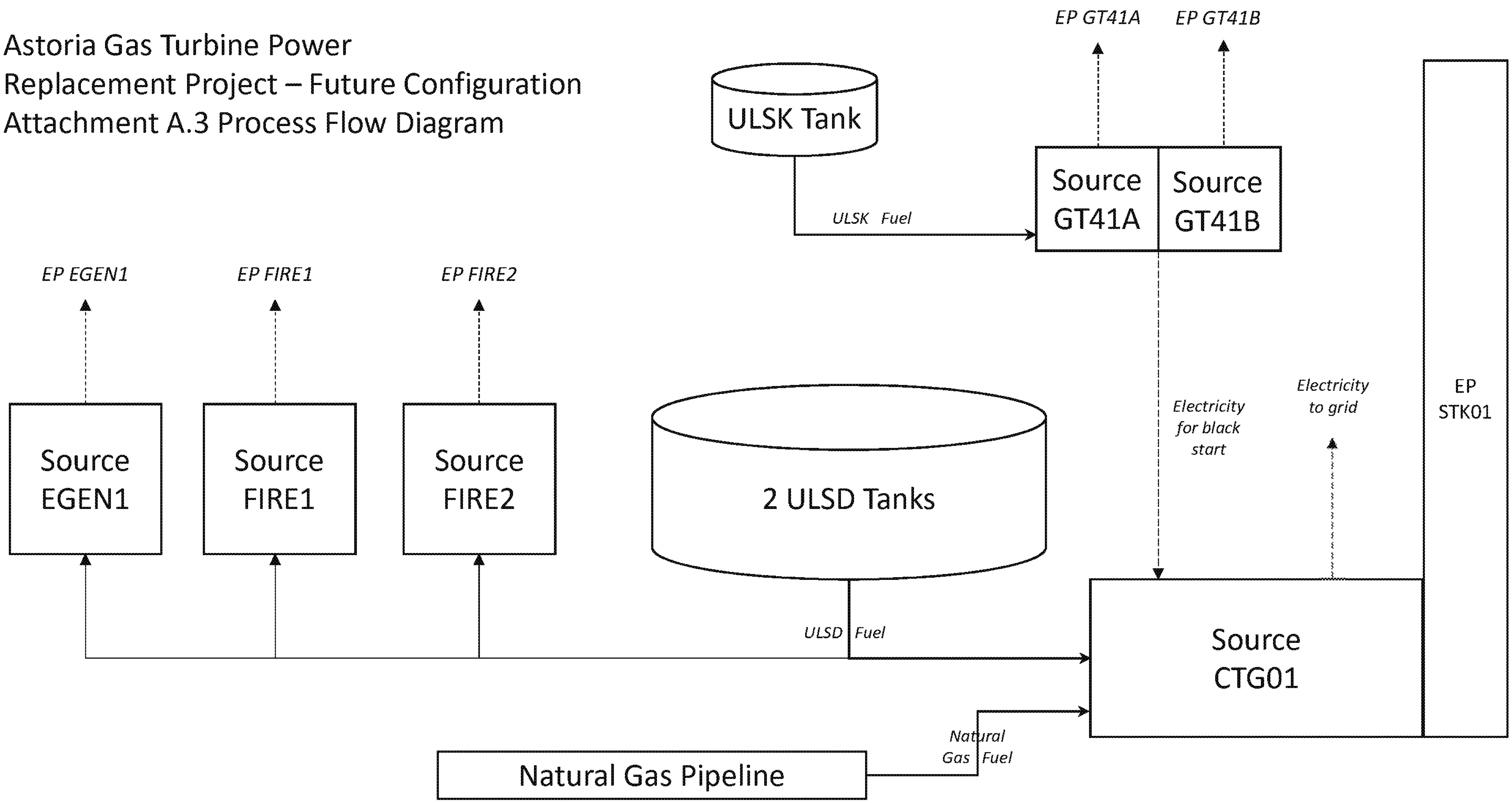
METHODS USED TO DETERMINE COMPLIANCE

Emission Unit ID	Applicable Requirement	Method Used to Determine Compliance and Corresponding Date
U-CTG01	40 CFR 60.4320 Subpart KKKK	Continuous emission monitoring: The new turbine will comply with the relevant NOx emission limitations using a NOx CEMS.
U-CTG01	40 CFR 60.4365 Subpart KKKK	Monitoring of process or control device parameters as surrogate: The new turbine will comply with the relevant fuel sulfur limitations using ULSD fuel sulfur receipts which are collected and maintained per delivery and natural gas tariff.
U-EGENS	6 NYCRR 231-8.7	Record keeping / maintenance procedure: The facility will limit operation of each engine to less than 500 hours of total operation. Each engine will be equipped with a non-resettable hour meter.
U-EGENS	6 NYCRR 231-8.7	Record keeping / maintenance procedure: Each engine purchased by the facility will be certified to meet the required particulate emission rates.
U-CTG01	6 NYCRR 231-8.7	Intermittent Emission Testing: The new turbine shall undergo stack testing for particulates once during the term of the permit.
U-CTG01	6 NYCRR 231-8.7	Record keeping / maintenance procedure: The facility will make a demonstration that the CO2e emission rate from the turbines is within the BACT emission rates.
U-CTG01	6 NYCRR 201-6	Intermittent Emission Testing: The new turbine shall undergo initial stack testing for VOCs.
U-CTG01	6 NYCRR 231-6	Continuous emission monitoring: The new turbine will comply with the NOx emission limitations using a NOx CEMS. Excess emissions will be reported quarterly.
U-CTG01	6 NYCRR 231-6	Continuous emission monitoring: The new turbine will comply with the CO emission limitations using a CO CEMS. Excess emissions will be reported quarterly.
U-CTG01	6 NYCRR 231-6	Continuous emission monitoring: The new turbine will comply with the NH3 emission limitation using a CEMS. Excess emissions will be reported quarterly.
U-CTG01	6 NYCRR 231-6	Record keeping / maintenance procedure: The duration of the new turbine's startup and shutdown will be tracked by the data acquisition and handling system.
U-CTG01	6 NYCRR 231-6	Continuous emission monitoring and Record keeping: the facility will track emissions of NOx, CO, and NH3 during startup and shutdown and prepare a permit modification request to the DEC.
U-CTG01	6 NYCRR 231-8.7	Record keeping / maintenance procedure: the facility will track fuel use of ULSD during all modes of operation using a calibrated fuel meter and maintain records to demonstrate compliance with the rolling 12 month total limitation.

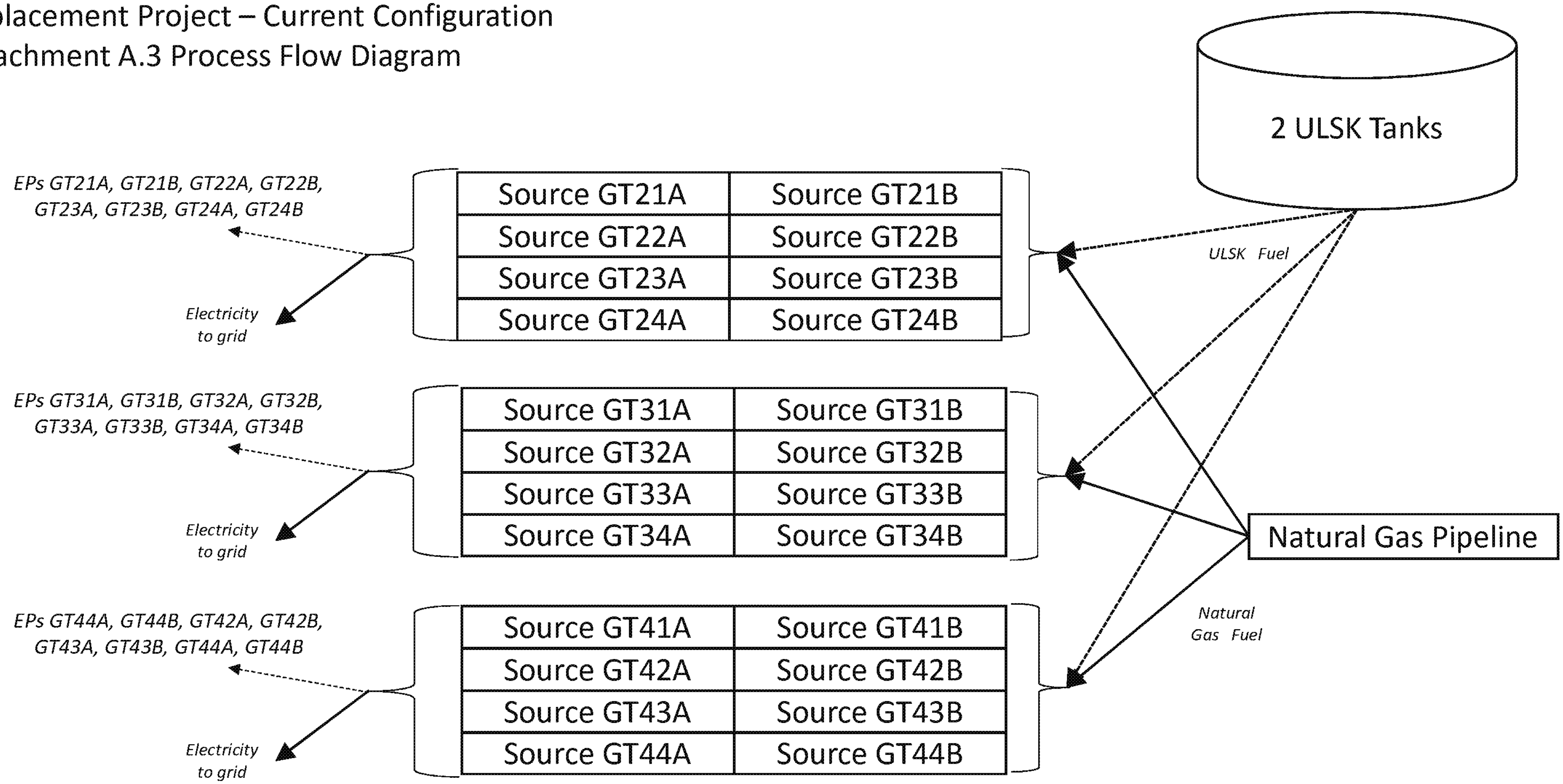
Attachment A-3

Process Flow Diagram

Astoria Gas Turbine Power
Replacement Project – Future Configuration
Attachment A.3 Process Flow Diagram



Astoria Gas Turbine Power
Replacement Project – Current Configuration
Attachment A.3 Process Flow Diagram



Note: Each turbine unit has a separate emission point, shown combined for illustrative purposes

Attachment A-4

Acid Rain Application Signed

United States
Environmental Protection Agency
Acid Rain Program

OMB No. 2060-0258
Approval expires 12/31/2021

Acid Rain Permit Application

For more information, see instructions and 40 CFR 72.30 and 72.31.

This submission is: ☑ new ☐ revised ☐ for ARP permit renewal

STEP 1

Identify the facility name, State, and plant (ORIS) code.

Facility (Source) Name	State	Plant Code
Astoria Gas Turbine Power	NY	55243

STEP 2

Enter the unit ID# for every affected unit at the affected source in column "a."

a	b
Unit ID#	Unit Will Hold Allowances in Accordance with 40 CFR 72.9(c)(1)
CTG01	Yes
	Yes
	Yes
	Yes
	Yes
	Yes
	Yes
	Yes
	Yes
	Yes
	Yes
	Yes
	Yes
	Yes
	Yes
	Yes
	Yes
	Yes
	Yes
	Yes

Astoria Gas Turbine Power
Facility (Source) Name (from STEP 1)

STEP 3

Read the standard requirements.

Permit Requirements

(1) The designated representative of each affected source and each affected unit at the source shall:
  (i) Submit a complete Acid Rain permit application (including a compliance plan) under 40 CFR part 72 in accordance with the deadlines specified in 40 CFR 72.30; and
  (ii) Submit in a timely manner any supplemental information that the permitting authority determines is necessary in order to review an Acid Rain permit application and issue or deny an Acid Rain permit;

(2) The owners and operators of each affected source and each affected unit at the source shall:
  (i) Operate the unit in compliance with a complete Acid Rain permit application or a superseding Acid Rain permit issued by the permitting authority; and
  (ii) Have an Acid Rain Permit.

Monitoring Requirements

(1) The owners and operators and, to the extent applicable, designated representative of each affected source and each affected unit at the source shall comply with the monitoring requirements as provided in 40 CFR part 75.

(2) The emissions measurements recorded and reported in accordance with 40 CFR part 75 shall be used to determine compliance by the source or unit, as appropriate, with the Acid Rain emissions limitations and emissions reduction requirements for sulfur dioxide and nitrogen oxides under the Acid Rain Program.

(3) The requirements of 40 CFR part 75 shall not affect the responsibility of the owners and operators to monitor emissions of other pollutants or other emissions characteristics at the unit under other applicable requirements of the Act and other provisions of the operating permit for the source.

Sulfur Dioxide Requirements

(1) The owners and operators of each source and each affected unit at the source shall:
  (i) Hold allowances, as of the allowance transfer deadline, in the source's compliance account (after deductions under 40 CFR 73.34(c)), not less than the total annual emissions of sulfur dioxide for the previous calendar year from the affected units at the source; and
  (ii) Comply with the applicable Acid Rain emissions limitations for sulfur dioxide.

(2) Each ton of sulfur dioxide emitted in excess of the Acid Rain emissions limitations for sulfur dioxide shall constitute a separate violation of the Act.

(3) An affected unit shall be subject to the requirements under paragraph (1) of the sulfur dioxide requirements as follows:
  (i) Starting January 1, 2000, an affected unit under 40 CFR 72.6(a)(2); or
  (ii) Starting on the later of January 1, 2000 or the deadline for monitor certification under 40 CFR part 75, an affected unit under 40 CFR 72.6(a)(3).

(4) Allowances shall be held in, deducted from, or transferred among Allowance Tracking System accounts in accordance with the Acid Rain Program.

(5) An allowance shall not be deducted in order to comply with the requirements under paragraph (1) of the sulfur dioxide requirements prior to the calendar year for which the allowance was allocated.

(6) An allowance allocated by the Administrator under the Acid Rain Program is a limited authorization to emit sulfur dioxide in accordance with the Acid Rain Program. No provision of the Acid Rain Program, the Acid Rain permit application, the Acid Rain permit, or an exemption under 40 CFR 72.7 or 72.8 and no provision of law shall be construed to limit the authority of the United States to terminate or limit such authorization.

(7) An allowance allocated by the Administrator under the Acid Rain Program does not constitute a property right.

Nitrogen Oxides Requirements

The owners and operators of the source and each affected unit at the source shall comply with the applicable Acid Rain emissions limitation for nitrogen oxides.

STEP 3, Cont'd.

Excess Emissions Requirements

(1) The designated representative of an affected source that has excess emissions in any calendar year shall submit a proposed offset plan, as required under 40 CFR part 77.
(2) The owners and operators of an affected source that has excess emissions in any calendar year shall:
   (i) Pay without demand the penalty required, and pay upon demand the interest on that penalty, as required by 40 CFR part 77; and
   (ii) Comply with the terms of an approved offset plan, as required by 40 CFR part 77.

Recordkeeping and Reporting Requirements

(1) Unless otherwise provided, the owners and operators of the source and each affected unit at the source shall keep on site at the source each of the following documents for a period of 5 years from the date the document is created. This period may be extended for cause, at any time prior to the end of 5 years, in writing by the Administrator or permitting authority:
   (i) The certificate of representation for the designated representative for the source and each affected unit at the source and all documents that demonstrate the truth of the statements in the certificate of representation, in accordance with 40 CFR 72.24; provided that the certificate and documents shall be retained on site at the source beyond such 5-year period until such documents are superseded because of the submission of a new certificate of representation changing the designated representative;
   (ii) All emissions monitoring information, in accordance with 40 CFR part 75, provided that to the extent that 40 CFR part 75 provides for a 3-year period for recordkeeping, the 3-year period shall apply.
   (iii) Copies of all reports, compliance certifications, and other submissions and all records made or required under the Acid Rain Program; and,
   (iv) Copies of all documents used to complete an Acid Rain permit application and any other submission under the Acid Rain Program or to demonstrate compliance with the requirements of the Acid Rain Program.
(2) The designated representative of an affected source and each affected unit at the source shall submit the reports and compliance certifications required under the Acid Rain Program, including those under 40 CFR part 72 subpart I and 40 CFR part 75.

Liability

(1) Any person who knowingly violates any requirement or prohibition of the Acid Rain Program, a complete Acid Rain permit application, an Acid Rain permit, or an exemption under 40 CFR 72.7 or 72.8, including any requirement for the payment of any penalty owed to the United States, shall be subject to enforcement pursuant to section 113(c) of the Act.
(2) Any person who knowingly makes a false, material statement in any record, submission, or report under the Acid Rain Program shall be subject to criminal enforcement pursuant to section 113(c) of the Act and 18 U.S.C. 1001.
(3) No permit revision shall excuse any violation of the requirements of the Acid Rain Program that occurs prior to the date that the revision takes effect.
(4) Each affected source and each affected unit shall meet the requirements of the Acid Rain Program.
(5) Any provision of the Acid Rain Program that applies to an affected source (including a provision applicable to the designated representative of an affected source) shall also apply to the owners and operators of such source and of the affected units at the source.
(6) Any provision of the Acid Rain Program that applies to an affected unit (including a provision applicable to the designated representative of an affected unit) shall also apply to the owners and operators of such unit.
(7) Each violation of a provision of 40 CFR parts 72, 73, 74, 75, 76, 77, and 78 by an affected source or affected unit, or by an owner or operator or designated representative of such source or unit, shall be a separate violation of the Act.

Astoria Gas Turbine Power
Facility (Source) Name (from STEP 1)

STEP 3, Cont'd.

Effect on Other Authorities

No provision of the Acid Rain Program, an Acid Rain permit application, an Acid Rain permit, or an exemption under 40 CFR 72.7 or 72.8 shall be construed as:

(1) Except as expressly provided in title IV of the Act, exempting or excluding the owners and operators and, to the extent applicable, the designated representative of an affected source or affected unit from compliance with any other provision of the Act, including the provisions of title I of the Act relating to applicable National Ambient Air Quality Standards or State Implementation Plans;
(2) Limiting the number of allowances a source can hold; provided, that the number of allowances held by the source shall not affect the source's obligation to comply with any other provisions of the Act;
(3) Requiring a change of any kind in any State law regulating electric utility rates and charges, affecting any State law regarding such State regulation, or limiting such State regulation, including any prudence review requirements under such State law;
(4) Modifying the Federal Power Act or affecting the authority of the Federal Energy Regulatory Commission under the Federal Power Act; or,
(5) Interfering with or impairing any program for competitive bidding for power supply in a State in which such program is established.

STEP 4

Certification

Read the certification statement, sign, and date.

I am authorized to make this submission on behalf of the owners and operators of the affected source or affected units for which the submission is made. I certify under penalty of law that I have personally examined, and am familiar with, the statements and information submitted in this document and all its attachments. Based on my inquiry of those individuals with primary responsibility for obtaining the information, I certify that the statements and information are to the best of my knowledge and belief true, accurate, and complete. I am aware that there are significant penalties for submitting false statements and information or omitting required statements and information, including the possibility of fine or imprisonment.

Name Andrew Scano

Date 04/24/2020

Digitally signed by Andrew Scano
Date: 2020-04-24 09:05-04:00

Instructions for the Acid Rain Program Permit Application

The Acid Rain Program requires the designated representative to submit an Acid Rain permit application for each source with an affected unit. A complete Certificate of Representation must be received by EPA before the permit application is submitted to the Title V permitting authority. A complete Acid Rain permit application, once submitted, is binding on the owners and operators of the affected source and is enforceable in the absence of a permit until the Title V permitting authority either issues a permit to the source or disapproves the application.

Please type or print. If assistance is needed, contact the Title V permitting authority.

STEP 1 A Plant Code is a 4 or 5 digit number assigned by the Department of Energy's (DOE) Energy Information Administration (EIA) to facilities that generate electricity. For older facilities, "Plant Code" is synonymous with "ORISPL" and "Facility" codes. If the facility generates electricity but no Plant Code has been assigned, or if there is uncertainty regarding what the Plant Code is, send an email to the EIA. The email address is EIA-860@eia.gov.

STEP 2 In column "a," identify each unit at the facility by providing the appropriate unit identification number, consistent with the identifiers used in the Certificate of Representation and with submissions made to DOE and/or EIA. Do not list duct burners. For new units without identification numbers, owners and operators must assign identifiers consistent with EIA and DOE requirements. Each Acid Rain Program submission that includes the unit identification number(s) (e.g., Acid Rain permit applications, monitoring plans, quarterly reports, etc.) should reference those unit identification numbers in exactly the same way that they are referenced on the Certificate of Representation.

Submission Deadlines

For new units, an initial Acid Rain permit application must be submitted to the Title V permitting authority 24 months before the date the unit commences operation. Acid Rain permit renewal applications must be submitted at least 6 months in advance of the expiration of the acid rain portion of a Title V permit, or such longer time as provided for under the Title V permitting authority's operating permits regulation.

Submission Instructions

Submit this form to the appropriate Title V permitting authority. If you have questions regarding this form, contact your local, State, or EPA Regional Acid Rain contact, or call EPA's Clean Air Markets Hotline at (202)343-9620.

Paperwork Burden Estimate

The public reporting and record keeping burden for this collection of information is estimated to average 8 hours per response. Burden means the total time, effort, or financial resources expended by persons to generate, maintain, retain, or disclose or provide information to or for a Federal agency. This includes the time needed to review instructions; develop, acquire, install, and utilize technology and systems for the purposes of collecting, validating, and verifying information, processing and maintaining information, and disclosing and providing information; adjust the existing ways to comply with any previously applicable instructions and requirements; train personnel to be able to respond to a collection of information; search data sources; complete and review the collection of information; and transmit or otherwise disclose the information. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number.

Send comments on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including through the use of automated collection techniques to the Director, Collection Strategies Division, U.S. Environmental Protection Agency (2822T), 1200 Pennsylvania Ave., NW., Washington, D.C. 20460. Include the OMB control number in any correspondence. **Do not send the completed form to this address.**

Attachment A-5

Baseline Period Demonstration

NRG Astoria Turbine Replacement Project
Baseline Emissions for P&W Turbines to be Removed

GT21A, GT21B, GT22A, GT22B, GT23A, GT23B, GT24A, GT24B, GT31A, GT31B, GT32A, GT32B, GT33A, GT33B, GT34A, GT34B, GT42A, GT42G, GT43A, GT43B, GT44A, GT44B

		Uncorrected NOx	RACT Corrected NOx	VOC	SO2	CO	PM (tons)	PM10	PM2.5	Lead
Gas Factor	lb/MMBtu	Part 75 CEMS	0.368	0.0021	0.0034	0.386	0.0066	0.0066	0.0066	no factor
Kerosene Factor	lb/MMBtu	Part 75 CEMS	0.368	0.00041	0.0011	0.0761	Test Results 0.04675 for 2015 0.035 for 2016-2019	Test Results 0.04675 for 2015 0.035 for 2016-2019	Test Results 0.04675 for 2015 0.035 for 2016-2019	0.000014

Baseline Beginning	Baesline Ending	Gas Heat Input	Kero. Heat Input	Total Heat Input	Ucorr. NOx (tons)	RACT Corrected NOx (tons)	VOC (tons)	SO2 (tons)	CO (tons)	PM (tons)	PM10 (tons)	PM2.5 (tons)	Lead (tons)
January 2015	December 2016	569,900.50	23,853.10	593,753.60	149.46	109.25	0.60	0.98	110.90	2.36	2.36	2.36	0.0002
February 2015	January 2017	582,772.40	23,853.10	606,625.50	152.57	111.62	0.62	1.00	113.38	2.40	2.40	2.40	0.0002
March 2015	February 2017	594,291.94	15,873.46	610,165.40	151.88	112.27	0.63	1.02	115.30	2.25	2.25	2.25	0.0001
April 2015	March 2017	590,265.99	15,033.81	605,299.80	150.51	111.38	0.62	1.01	114.49	2.22	2.22	2.22	0.0001
May 2015	April 2017	616,570.68	14,805.93	631,376.60	156.87	116.17	0.65	1.06	119.56	2.30	2.30	2.30	0.0001
June 2015	May 2017	595,425.83	14,805.93	610,231.75	151.75	112.28	0.63	1.02	115.48	2.23	2.23	2.23	0.0001
July 2015	June 2017	605,539.53	14,805.93	620,345.45	154.22	114.14	0.64	1.04	117.43	2.26	2.26	2.26	0.0001
August 2015	July 2017	614,611.63	14,805.93	629,417.55	156.45	115.81	0.65	1.05	119.18	2.29	2.29	2.29	0.0001
September 2015	August 2017	595,176.98	14,805.93	609,982.90	151.73	112.24	0.63	1.02	115.43	2.23	2.23	2.23	0.0001
October 2015	September 2017	545,975.28	14,805.93	560,781.20	139.75	103.18	0.58	0.94	105.94	2.07	2.07	2.07	0.0001
November 2015	October 2017	538,497.03	15,755.78	554,252.80	138.33	101.98	0.57	0.92	104.53	2.06	2.06	2.06	0.0001
December 2015	November 2017	519,785.63	15,568.08	535,353.70	133.72	98.51	0.55	0.89	100.91	1.99	1.99	1.99	0.0001
January 2016	December 2017	514,660.93	18,245.58	532,906.50	133.64	98.05	0.54	0.88	100.02	2.02	2.02	2.02	0.0001
February 2016	January 2018	522,072.58	17,684.23	539,756.80	135.03	99.32	0.55	0.90	101.43	2.03	2.03	2.03	0.0001
March 2016	February 2018	523,031.30	13,317.35	536,348.65	133.10	98.69	0.55	0.90	101.45	1.96	1.96	1.96	0.0001
April 2016	March 2018	523,608.85	13,317.35	536,926.20	133.17	98.79	0.55	0.90	101.56	1.96	1.96	1.96	0.0001
May 2016	April 2018	509,185.90	14,661.20	523,847.10	130.23	96.39	0.54	0.87	98.83	1.94	1.94	1.94	0.0001
June 2016	May 2018	529,502.40	14,661.20	544,163.60	135.17	100.13	0.56	0.91	102.75	2.00	2.00	2.00	0.0001
July 2016	June 2018	519,963.70	14,661.20	534,624.90	132.82	98.37	0.55	0.89	100.91	1.97	1.97	1.97	0.0001
August 2016	July 2018	442,856.00	14,661.20	457,517.20	114.10	84.18	0.47	0.76	86.03	1.72	1.72	1.72	0.0001
September 2016	August 2018	379,649.60	14,661.20	394,310.80	98.69	72.55	0.40	0.65	73.83	1.51	1.51	1.51	0.0001
October 2016	September 2018	421,188.45	14,661.20	435,849.65	108.65	80.20	0.45	0.72	81.85	1.65	1.65	1.65	0.0001
November 2016	October 2018	422,427.20	9,253.25	431,680.45	106.54	79.43	0.45	0.72	81.88	1.56	1.56	1.56	0.0001
December 2016	November 2018	429,720.85	9,337.40	439,058.25	108.50	80.79	0.45	0.74	83.29	1.58	1.58	1.58	0.0001
January 2017	December 2018	439,772.35	15,681.80	455,454.15	115.17	83.80	0.46	0.76	85.47	1.73	1.73	1.73	0.0001
February 2017	January 2019	426,964.75	15,681.80	442,646.55	112.31	81.45	0.45	0.73	83.00	1.68	1.68	1.68	0.0001
March 2017	February 2019	415,813.15	15,171.80	430,984.95	109.40	79.30	0.44	0.72	80.83	1.64	1.64	1.64	0.0001
April 2017	March 2019	411,509.45	15,171.80	426,681.25	108.39	78.51	0.44	0.71	80.00	1.62	1.62	1.62	0.0001
May 2017	April 2019	393,619.95	15,498.20	409,118.15	104.12	75.28	0.42	0.68	76.56	1.57	1.57	1.57	0.0001
June 2017	May 2019	367,868.85	15,498.20	383,367.05	97.84	70.54	0.39	0.63	71.59	1.49	1.49	1.49	0.0001
July 2017	June 2019	358,624.55	15,498.20	374,122.75	95.56	68.84	0.38	0.62	69.80	1.45	1.45	1.45	0.0001
August 2017	July 2019	362,048.35	15,498.20	377,546.55	96.33	69.47	0.38	0.62	70.47	1.47	1.47	1.47	0.0001
September 2017	August 2019	366,392.55	15,498.20	381,890.75	97.36	70.27	0.39	0.63	71.30	1.48	1.48	1.48	0.0001
October 2017	September 2019	367,155.25	15,498.20	382,653.45	97.54	70.41	0.39	0.63	71.45	1.48	1.48	1.48	0.0001
November 2017	October 2019	367,578.76	14,906.19	382,484.95	97.56	70.38	0.39	0.63	71.51	1.47	1.47	1.47	0.0001
December 2017	November 2019	362,198.95	15,553.50	377,752.45	96.50	69.51	0.38	0.62	70.50	1.47	1.47	1.47	0.0001
January 2018	December 2019	351,731.40	11,915.55	363,646.95	92.46	66.91	0.37	0.60	68.34	1.37	1.37	1.37	0.0001

NRG Astoria Turbine Replacement Project
Baseline Emissions for P&W Turbines to be Remain
GT41A & GT41B

		Uncorrected NOx	RACT Corrected NOx	VOC	SO2	CO	PM (tons)	PM10	PM2.5	Lead
Gas Factor	lb/MMBtu	Part 75 CEMS	0.368	0.0021	0.0034	0.386	0.0066	0.0066	0.0066	no factor
Kerosene Factor	lb/MMBtu	Part 75 CEMS	0.368	0.00041	0.0011	0.0761	Test Results 0.04675 for 2015 0.035 for 2016-2019	Test Results 0.04675 for 2015 0.035 for 2016-2019	Test Results 0.04675 for 2015 0.035 for 2016-2019	0.000014

Baseline Beginning	Baesline Ending	Gas Heat Input	Kero. Heat Input	Total Heat Input	Ucorr. NOx (tons)	RACT Corrected NOx (tons)	VOC (tons)	SO2 (tons)	CO (tons)	PM (tons)	PM10 (tons)	PM2.5 (tons)	Lead (tons)
January 2015	December 2016	75,121.92	5,248.28	80,370.20	20.21	14.79	0.08	0.13	14.70	0.36	0.36	0.36	0.00004
February 2015	January 2017	74,222.52	5,503.28	79,725.80	20.10	14.67	0.08	0.13	14.53	0.36	0.36	0.36	0.00004
March 2015	February 2017	73,953.60	2,656.20	76,609.80	18.79	14.10	0.08	0.13	14.37	0.30	0.30	0.30	0.00002
April 2015	March 2017	71,215.28	1,753.13	72,968.40	17.79	13.43	0.08	0.12	13.81	0.27	0.27	0.27	0.00001
May 2015	April 2017	68,114.98	1,753.13	69,868.10	17.03	12.86	0.07	0.12	13.21	0.26	0.26	0.26	0.00001
June 2015	May 2017	57,683.63	1,753.13	59,436.75	14.49	10.94	0.06	0.10	11.20	0.22	0.22	0.22	0.00001
July 2015	June 2017	54,251.28	1,753.13	56,004.40	13.64	10.30	0.06	0.09	10.54	0.21	0.21	0.21	0.00001
August 2015	July 2017	53,493.13	1,753.13	55,246.25	13.44	10.17	0.06	0.09	10.39	0.21	0.21	0.21	0.00001
September 2015	August 2017	48,999.33	1,753.13	50,752.45	12.34	9.34	0.05	0.08	9.52	0.19	0.19	0.19	0.00001
October 2015	September 2017	44,754.53	1,753.13	46,507.65	11.30	8.56	0.05	0.08	8.70	0.18	0.18	0.18	0.00001
November 2015	October 2017	45,239.48	1,816.88	47,056.35	11.45	8.66	0.05	0.08	8.80	0.18	0.18	0.18	0.00001
December 2015	November 2017	44,508.78	1,816.88	46,325.65	11.27	8.52	0.05	0.08	8.66	0.18	0.18	0.18	0.00001
January 2016	December 2017	44,026.68	2,008.13	46,034.80	11.24	8.47	0.05	0.08	8.57	0.18	0.18	0.18	0.00001
February 2016	January 2018	43,847.88	1,880.63	45,728.50	11.12	8.41	0.05	0.08	8.53	0.18	0.18	0.18	0.00001
March 2016	February 2018	43,660.90	1,020.00	44,680.90	10.73	8.22	0.05	0.07	8.47	0.16	0.16	0.16	0.00001
April 2016	March 2018	41,133.10	1,020.00	42,153.10	10.11	7.76	0.04	0.07	7.98	0.15	0.15	0.15	0.00001
May 2016	April 2018	36,058.10	1,020.00	37,078.10	8.89	6.82	0.04	0.06	7.00	0.14	0.14	0.14	0.00001
June 2016	May 2018	37,180.80	1,020.00	38,200.80	9.15	7.03	0.04	0.06	7.21	0.14	0.14	0.14	0.00001
July 2016	June 2018	36,769.00	1,020.00	37,789.00	9.06	6.95	0.04	0.06	7.14	0.14	0.14	0.14	0.00001
August 2016	July 2018	28,567.80	1,020.00	29,587.80	7.14	5.44	0.03	0.05	5.55	0.11	0.11	0.11	0.00001
September 2016	August 2018	22,172.00	1,020.00	23,192.00	5.64	4.27	0.02	0.04	4.32	0.09	0.09	0.09	0.00001
October 2016	September 2018	28,854.10	1,020.00	29,874.10	7.21	5.50	0.03	0.05	5.61	0.11	0.11	0.11	0.00001
November 2016	October 2018	30,224.05	1,083.75	31,307.80	7.56	5.76	0.03	0.05	5.87	0.12	0.12	0.12	0.00001
December 2016	November 2018	30,087.00	1,050.60	31,137.60	7.53	5.73	0.03	0.05	5.85	0.12	0.12	0.12	0.00001
January 2017	December 2018	30,890.80	1,050.60	31,941.40	7.72	5.88	0.03	0.05	6.00	0.12	0.12	0.12	0.00001
February 2017	January 2019	30,493.80	795.60	31,289.40	7.50	5.76	0.03	0.05	5.92	0.11	0.11	0.11	0.00001
March 2017	February 2019	29,320.20	795.60	30,115.80	7.23	5.54	0.03	0.05	5.69	0.11	0.11	0.11	0.00001
April 2017	March 2019	26,321.00	795.60	27,116.60	6.53	4.99	0.03	0.05	5.11	0.10	0.10	0.10	0.00001
May 2017	April 2019	27,374.45	859.35	28,233.80	6.80	5.20	0.03	0.05	5.32	0.11	0.11	0.11	0.00001
June 2017	May 2019	26,502.45	859.35	27,361.80	6.60	5.03	0.03	0.05	5.15	0.10	0.10	0.10	0.00001
July 2017	June 2019	27,386.65	859.35	28,246.00	6.81	5.20	0.03	0.05	5.32	0.11	0.11	0.11	0.00001
August 2017	July 2019	30,759.25	859.35	31,618.60	7.60	5.82	0.03	0.05	5.97	0.12	0.12	0.12	0.00001
September 2017	August 2019	32,367.75	859.35	33,227.10	7.97	6.11	0.03	0.06	6.28	0.12	0.12	0.12	0.00001
October 2017	September 2019	33,825.25	859.35	34,684.60	8.31	6.38	0.04	0.06	6.56	0.13	0.13	0.13	0.00001
November 2017	October 2019	34,089.95	828.75	34,918.70	8.36	6.43	0.04	0.06	6.61	0.13	0.13	0.13	0.00001
December 2017	November 2019	34,036.90	887.40	34,924.30	8.37	6.43	0.04	0.06	6.60	0.13	0.13	0.13	0.00001
January 2018	December 2019	31,978.25	639.95	32,618.20	7.78	6.00	0.03	0.05	6.20	0.12	0.12	0.12	0.00000

NRG Astoria Turbine Replacement Project

Kero. Heat Input (MMBtu) Based on total heat input and apportioned by kerosene use

Month	Year	CT2-1A	CT2-1B	CT2-2A	CT2-2B	CT2-3A	CT2-3B	CT2-4A	CT2-4B	CT3-1A	CT3-1B	CT3-2A	CT3-2B	CT3-3A	CT3-3B	CT3-4A	CT3-4B	CT4-1A	CT4-1B	CT4-2A	CT4-2B	CT4-3A	CT4-3B	CT4-4A	CT4-4B	Monthly Kero. Heat Input (MMBtu)	Monthly Kero. Heat Input (MMBtu)
To be Removed?		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Curtailed	Curtailed	Yes	Yes	Yes	Yes	Yes	Yes	22 turbines	GT 4-1 A & B
January	2015	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
February	2015	1,910.80	1,910.80	387.30	387.30	719.70	719.70	1,530.00	1,530.00	-	-	276.60	276.60	888.03	888.03	294.90	294.90	2,847.08	2,847.08	2,338.50	2,338.50	143.80	143.80	-	-	16,979.27	5,694.16
March	2015	-	-	-	-	234.30	234.30	-	-	-	-	-	-	-	-	-	-	903.07	903.07	605.35	605.35	-	-	-	-	1,679.31	1,806.15
April	2015	-	-	-	-	-	-	-	-	-	-	227.88	227.88	-	-	-	-	-	-	-	-	-	-	-	-	455.77	-
May	2015	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
June	2015	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
July	2015	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
August	2015	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
September	2015	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
October	2015	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
November	2015	-	-	-	-	-	-	-	-	60.20	60.20	-	-	-	-	-	-	-	-	-	-	-	-	127.50	127.50	375.40	-
December	2015	127.50	127.50	127.50	127.50	63.75	63.75	255.00	255.00	63.75	63.75	63.75	63.75	127.50	127.50	63.75	63.75	127.50	127.50	127.50	127.50	-	-	-	-	2,040.00	255.00
January	2016	382.50	382.50	-	-	-	-	382.50	382.50	-	-	-	-	382.50	382.50	-	-	382.50	382.50	370.10	370.10	382.50	382.50	-	-	3,800.20	765.00
February	2016	637.50	637.50	382.50	382.50	-	-	318.75	318.75	-	-	-	-	637.50	637.50	956.25	956.25	573.75	1,147.50	892.50	318.75	573.75	573.75	255.00	255.00	8,733.75	1,721.25
March	2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
April	2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
May	2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
June	2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
July	2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
August	2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
September	2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
October	2016	1,785.00	1,785.00	1,211.25	1,211.25	-	-	-	-	1,721.25	1,721.25	127.50	127.50	-	-	1,466.25	1,466.25	-	-	-	-	-	-	-	-	12,622.50	-
November	2016	-	-	-	-	-	-	-	-	-	127.50	127.50	-	127.50	127.50	63.75	63.75	127.50	127.50	-	-	-	-	-	-	637.50	255.00
December	2016	-	-	191.25	191.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	382.50	-
January	2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	255.00	255.00	-	-	-	-	-	-	-	510.00
February	2017	-	-	127.50	127.50	-	-	127.50	127.50	-	-	127.50	127.50	-	-	-	-	-	-	127.50	127.50	-	-	-	-	1,020.00	-
March	2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
April	2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
May	2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
June	2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
July	2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
August	2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
September	2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
October	2017	63.75	63.75	62.90	62.90	127.50	127.50	-	-	63.75	63.75	127.50	127.50	58.20	58.20	191.25	191.25	63.75	63.75	63.75	63.75	127.50	127.50	63.75	63.75	1,899.70	127.50
November	2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
December	2017	573.75	573.75	127.50	127.50	127.50	127.50	510.00	510.00	446.25	446.25	-	-	382.50	382.50	382.50	382.50	318.75	318.75	446.25	446.25	510.00	510.00	191.25	191.25	7,395.00	637.50
January	2018	191.25	191.25	-	-	446.25	446.25	-	-	-	-	-	-	-	-	-	-	255.00	255.00	-	-	701.25	701.25	-	-	2,677.50	510.00
February	2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
March	2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
April	2018	451.35	451.35	446.25	446.25	446.25	446.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,687.70	-
May	2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
June	2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
July	2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
August	2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
September	2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
October	2018	-	-	76.50	76.50	84.15	84.15	-	-	272.85	272.85	145.35	145.35	-	-	94.35	94.35	63.75	63.75	71.40	71.40	87.30	87.30	71.40	71.40	1,806.60	127.50
November	2018	56.10	56.10	63.75	63.75	30.60	30.60	-	-	-	-	-	-	-	-	-	-	94.35	94.35	33.15	33.15	96.90	96.90	122.40	122.40	805.80	188.70
December	2018	369.75	369.75	38.25	38.25	20.40	20.40	1,402.50	1,402.50	765.00	765.00	382.50	382.50	701.25	701.25	114.75	114.75	-	-	-	-	765.00	765.00	1,976.25	1,976.25	13,071.30	-
January	2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
February	2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
March	2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
April	2019	56.10	56.10	58.65	58.65	38.25	38.25	56.10	56.10	-	-	-	-	-	-	-	-	63.75	63.75	-	-	53.55	53.55	63.75	63.75	652.80	127.50
May	2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
June	2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
July	2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
August	2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
September	2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
October	2019	-	-	-	-	-	-	-	-	51.00	51.00	165.75	165.75	20.30	20.30	11.14	11.14	33.15	33.15	45.90	45.90	25.50	25.50	38.25	38.25	715.69	66.30
November	2019	48.80	48.80	30.60	30.60	27.52	27.52	56.30	56.30	47.50	47.50	48.45	48.45	42.50	42.50	45.33	45.33	58.65	58.65	124.95	124.95	109.65	109.65	65.71	65.71	1,294.61	117.30
December	2019	-	-	33.15	33.15	-	-	26.40	26.40	-	-	-	-	-	-	-	-	71.30	71.30	-	-	-	-	-	-	119.10	142.60

NRG Astoria Turbine Replacement Project

Gas Heat Input (MMBtu) Based on total heat input and apportioned by kerosene and natural gas use

Month	Year	CT2-1A	CT2-1B	CT2-2A	CT2-2B	CT2-3A	CT2-3B	CT2-4A	CT2-4B	CT3-1A	CT3-1B	CT3-2A	CT3-2B	CT3-3A	CT3-3B	CT3-4A	CT3-4B	CT4-1A	CT4-1B	CT4-2A	CT4-2B	CT4-3A	CT4-3B	CT4-4A	CT4-4B	Monthly Gas Heat Input (MMBtu)	Monthly Gas Heat Input (MMBtu)
To be Removed?		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Curtailed	Curtailed	Yes	Yes	Yes	Yes	Yes	Yes	22 turbines	GT 4-1 A & B
January	2015	523.70	523.70	285.40	285.40	370.90	370.90	479.60	479.60	355.70	355.70	293.80	293.80	489.00	489.00	390.10	390.10	1,296.40	1,296.40	532.30	532.30	409.40	409.40	0.70	0.70	8,261.20	2,592.80
February	2015	-	-	-	-	-	-	940.30	940.30	-	-	-	-	692.67	692.67	-	-	1,442.52	1,442.52	-	-	-	-	-	-	3,265.93	2,885.04
March	2015	4,529.80	4,529.80	1,689.50	1,689.50	1,122.30	1,122.30	4,858.90	4,858.90	558.50	558.50	1,280.90	1,280.90	3,326.80	3,326.80	788.00	788.00	5,737.53	5,737.53	1,101.75	1,101.75	1,109.60	1,109.60	1,458.90	1,458.90	43,649.89	11,475.05
April	2015	350.80	350.80	-	-	-	-	673.60	673.60	-	-	278.02	278.02	586.20	586.20	364.90	364.90	3,100.30	3,100.30	1,155.80	1,099.60	495.00	495.00	551.20	551.20	8,854.83	6,200.60
May	2015	613.20	613.20	566.20	566.20	-	-	2.50	2.50	3,487.40	3,302.30	4,229.00	4,229.00	4,728.60	4,728.60	4,341.10	4,341.10	11,634.50	11,400.80	10,785.80	10,441.40	9,593.30	9,593.30	9,481.50	9,481.50	95,127.70	23,035.30
June	2015	1,662.40	1,664.50	1,270.40	1,223.00	1,547.00	1,547.00	1,684.60	1,684.60	1,246.10	1,118.20	1,055.90	1,055.90	1,600.40	1,600.40	1,049.70	1,049.70	5,330.70	5,336.20	3,660.80	3,660.80	2,253.90	2,253.90	2,129.60	2,129.60	38,148.40	10,666.90
July	2015	1,344.70	1,344.70	983.90	983.90	1,403.60	1,403.60	2,379.60	2,384.40	885.30	804.60	425.20	425.20	1,398.90	1,398.90	1,039.90	1,039.90	1,997.10	2,147.80	936.30	932.00	1,065.40	1,065.40	674.10	674.10	24,993.60	4,144.90
August	2015	3,240.50	3,240.50	2,028.80	2,028.80	953.80	954.00	4,005.20	4,005.20	1,332.00	1,264.50	1,864.60	1,864.60	3,608.20	3,608.20	1,771.60	1,771.60	4,767.60	4,767.60	2,864.30	2,864.30	2,015.70	2,015.70	1,652.60	1,652.60	50,607.30	9,535.20
September	2015	5,687.00	5,689.50	6,820.30	6,803.60	4,606.50	4,617.50	5,934.30	5,934.30	1,104.70	926.90	3,655.10	3,655.10	1,800.30	1,800.30	5,114.40	5,114.40	4,956.60	4,956.60	7,347.50	7,347.50	5,418.70	5,418.70	8,715.00	8,715.00	112,226.60	9,913.20
October	2015	1,091.60	1,091.60	3,316.30	3,316.30	357.60	357.60	980.20	980.20	616.20	616.20	2,235.50	2,235.50	341.30	341.30	4,072.60	4,072.60	-	-	336.10	336.10	317.20	317.20	910.70	910.70	29,150.60	-
November	2015	3,244.60	3,231.20	5,734.80	5,734.80	602.60	602.60	4,576.80	4,576.80	-	-	2,563.30	2,563.30	113.90	113.90	2,122.00	2,122.00	791.70	791.70	2,385.40	2,385.40	1,171.10	1,171.10	2,323.80	2,323.80	49,663.20	1,583.40
December	2015	2,357.00	2,357.00	1,198.30	1,198.30	575.25	575.25	2,357.80	2,357.80	1,105.95	1,105.95	2,290.55	2,290.55	1,433.90	1,433.90	3,304.25	3,304.25	2,693.00	2,388.50	2,295.00	2,295.00	1,684.20	1,684.20	4,585.40	4,585.40	46,375.20	5,081.50
January	2016	318.60	318.60	358.00	358.00	-	-	273.90	273.90	-	-	-	-	275.30	275.30	59.80	59.80	604.50	604.50	-	-	49.30	49.30	-	-	2,669.80	1,209.00
February	2016	848.50	873.00	274.00	274.00	-	-	576.45	576.45	-	-	358.80	358.80	558.50	558.50	598.55	598.55	783.25	209.50	341.30	915.05	659.95	659.95	361.90	361.90	9,754.15	992.75
March	2016	328.20	393.90	477.40	477.40	358.10	358.10	1,670.80	1,670.80	538.20	538.20	299.00	299.00	2,033.20	2,033.20	478.40	478.40	3,022.70	3,022.70	987.00	987.00	616.80	616.80	555.10	555.10	16,750.10	6,045.40
April	2016	2,402.80	2,402.80	3,766.40	3,766.40	2,143.00	2,143.00	3,701.60	3,701.60	1,664.50	1,664.50	1,367.30	1,367.30	2,258.90	2,258.90	772.70	772.70	5,754.60	5,754.60	4,855.20	4,855.20	1,858.10	1,858.10	4,975.10	4,975.10	59,531.20	11,509.20
May	2016	291.00	291.00	1,047.60	1,047.60	291.00	291.00	1,571.40	1,571.40	2,774.20	2,774.20	2,321.30	2,321.30	339.70	339.70	849.30	849.30	856.80	856.80	1,252.20	1,252.20	1,779.60	1,779.60	1,647.60	1,647.60	28,329.80	1,713.60
June	2016	2,677.20	2,677.20	3,259.20	3,259.20	1,920.60	1,920.60	3,375.60	3,375.60	4,586.40	4,586.40	2,208.20	2,208.20	1,698.50	1,698.50	1,925.10	1,925.10	1,779.80	1,779.80	2,109.20	2,109.20	4,350.10	4,350.10	1,779.60	1,779.60	59,779.40	3,559.60
July	2016	7,771.40	7,771.40	9,832.00	9,832.00	7,123.80	7,123.80	7,418.20	7,418.20	9,726.30	9,726.30	10,374.60	10,374.60	7,545.30	7,545.30	5,776.70	5,776.70	8,251.10	8,251.10	9,693.60	9,693.60	10,616.80	10,616.80	8,251.10	8,251.10	188,259.60	16,502.20
August	2016	7,712.10	7,712.10	10,244.00	10,244.00	4,415.50	4,415.50	5,887.20	5,887.20	10,020.70	10,020.70	7,957.70	7,957.70	6,543.10	6,543.10	3,772.40	3,772.40	7,443.30	7,443.30	8,020.30	8,020.30	9,174.30	9,174.30	6,866.30	6,866.30	161,227.20	14,886.60
September	2016	529.90	529.90	1,354.10	1,354.10	117.70	117.70	117.70	117.70	1,650.30	1,650.30	1,002.10	1,002.10	353.60	353.60	707.30	707.30	1,096.30	1,096.30	634.70	634.70	750.10	750.10	634.70	634.70	15,704.40	2,192.60
October	2016	186.90	186.90	1,537.55	1,537.55	-	-	298.80	298.80	2,552.75	2,552.75	1,547.60	1,547.60	404.30	404.30	266.35	266.35	59.70	59.70	775.70	775.70	1,730.20	1,730.20	119.30	119.30	18,838.90	119.40
November	2016	1,613.60	1,613.60	597.70	597.70	537.90	537.90	597.70	597.70	3,754.50	3,627.00	2,587.40	2,714.90	103.70	103.70	167.45	167.45	1,125.60	1,125.60	2,625.50	2,625.50	3,043.10	3,043.10	1,789.90	1,789.90	34,836.90	2,251.20
December	2016	597.70	597.70	2,259.05	2,259.05	1,075.70	1,075.70	717.20	717.20	2,888.10	2,888.10	1,848.40	1,848.40	115.50	115.50	115.50	115.50	1,074.20	1,074.20	2,029.00	2,029.00	3,699.90	3,699.90	1,551.50	1,551.50	33,795.10	2,148.40
January	2017	664.40	664.40	2,416.00	2,416.00	3,382.40	3,382.40	1,328.80	1,328.80	707.70	707.70	1,633.20	1,633.20	707.70	707.70	489.90	489.90	397.00	397.00	2,347.20	2,347.20	1,890.80	1,890.80	1,434.40	1,434.40	34,005.00	794.00
February	2017	1,147.60	1,147.60	1,201.30	1,201.30	1,268.40	1,268.40	1,261.70	1,261.70	1,197.60	1,197.60	1,777.90	1,777.90	707.80	707.80	870.90	870.90	1,173.60	1,173.60	654.90	654.90	2,021.20	2,021.20	1,043.20	1,043.20	26,305.00	2,347.20
March	2017	181.20	181.20	1,751.60	1,751.60	1,389.20	1,389.20	543.60	543.60	871.00	871.00	2,123.20	2,123.20	3,320.90	3,320.90	381.10	381.10	2,999.20	2,999.20	1,695.20	1,695.20	4,172.80	4,172.80	1,369.20	1,369.20	35,598.00	5,998.40
April	2017	1,765.00	1,765.00	2,373.50	2,373.50	2,738.60	2,738.60	5,659.70	5,659.70	2,856.60	2,856.60	3,291.30	3,291.30	5,030.10	5,030.10	7,017.30	7,017.30	-	-	-	-	-	-	-	-	61,464.20	-
May	2017	3,292.60	3,292.60	2,043.60	2,043.60	3,349.60	3,349.60	1,589.60	1,589.60	2,347.50	2,347.50	3,664.60	3,664.60	572.60	572.60	3,149.10	3,149.10	1,086.30	1,086.30	1,140.70	1,140.70	2,390.10	2,390.10	2,879.00	2,879.00	52,838.00	2,172.60
June	2017	4,825.50	4,825.50	1,816.80	1,816.80	3,236.00	3,236.00	2,157.40	2,157.40	2,977.40	2,977.40	3,435.50	3,435.50	1,546.10	1,546.10	3,435.40	3,435.40	1,901.10	1,901.10	1,955.40	1,955.40	1,846.80	1,846.80	1,955.60	1,955.60	58,375.80	3,802.20
July	2017	4,336.40	4,336.40	1,230.60	1,230.60	1,816.60	1,816.60	2,344.00	2,344.00	1,283.60	1,283.60	2,275.40	2,275.40	875.10	875.10	2,917.10	2,917.10	1,314.30	1,314.30	711.90	711.90	1,752.20	1,752.20	2,026.00	2,026.00	43,137.80	2,628.60
August	2017	1,465.00	1,465.00	527.40	527.40	761.80	761.80	58.60	58.60	758.50	758.50	991.70	991.70	466.60	466.60	291.70	291.70	273.80	273.80	54.80	54.80	54.80	54.80	438.10	438.10	11,738.00	547.60
September	2017	293.00	293.00	293.00	293.00	293.00	293.00	234.40	234.40	116.70	116.70	525.10	525.10	1,225.30	1,225.30	350.00	350.00	711.80	711.80	1,095.10	1,095.10	2,102.70	2,102.70	383.30	383.30	13,823.20	1,423.60
October	2017	691.05	691.05	-	-	187.00	187.00	62.90	62.90	343.75	343.75	338.20	338.20	-	-	2,254.15	2,254.15	484.95	484.95	1,399.45	1,399.45	1,701.40	1,701.40	119.15	119.15	14,194.10	969.90
November	2017	1,698.30	1,698.30	-	-	-	-	566.10	566.10	291.10	291.10	-	-	1,397.30	1,397.30	582.20	582.20	61.00	61.00	122.00	122.00	1,341.20	1,341.20	122.00	122.00	12,240.40	122.00
December	2017	3,326.05	3,326.05	61.20	61.20	941.80	941.80	2,006.00	2,006.00	660.05	660.05	349.40	349.40	898.40	898.40	665.60	665.60	2,058.65	2,058.65	2,540.75	2,540.75	4,976.10	4,976.10	1,637.55	1,637.55	36,125.80	4,117.30
January	2018	1,060.35	1,060.35	658.80	658.80	410.15	410.15	922.40	922.40	337.60	337.60	337.60	337.60	618.90	618.90	337.60	337.60	425.70	425.70	1,670.70	1,670.70	2,021.15	2,021.15	371.30	371.30	17,493.10	851.40
February	2018	1,712.60	1,712.60	-	-	-	-	-	-	-	-	-	-	562.60	562.60	281.30	281.30	309.40	309.40	1,237.60	1,237.60	2,041.70	2,041.70	-	-	11,671.60	618.80
March	2018	1,910.20	1,910.20	131.70	131.70	131.70	131.70	197.60	197.60	225.10	225.10	618.90	618.90	900.20	900.20	506.40	506.40	494.90	494.90	1,422.90	1,422.90	2,907.90	2,907.90	-	-	17,905.20	989.80
April	2018	1,176.55	1,176.55	409.15	409.15	547.05	547.05	69.00	69.00	316.10	316.10	316.10	316.10	3,105.00	3,105.00	1,580.30	1,580.30	679.60	679.60	1,767.00	1,767.00	4,629.30	4,629.30	1,427.10	1,427.10	30,685.30	1,359.20
May	2018	6,824.30	6,824.30	2,253.00	2,253.00	4,979.10	4,979.10	4,428.40	4,428.40	2,214.10	2,214.10	1,523.80	1,523.80	1,838.20	1,838.20	790.50	790.50	1,979.50	1,979.50	3,450.70	3,450.70	4,000.80	4,000.80	2,178.50	2,178.50	68,962.80	3,959.00
June	2018	2,580.70	2,580.70	1,924.90	1,924.90	1,364.30	1,364.30	3,329.20	3,329.20	1,623.80	1,623.80	1,135.70	1,135.70	1,976.10	1,976.10	735.70	735.70	1,368.00	1,368.00	2,689.30	2,689.30	1,370.40	1,370.40	1,620.90	1,620.90	40,702.00	2,736.00
July	2018	3,463.70	3,463.70	1,632.00	1,640.20	2,457.20	2,457.20	3,968.20	3,973.00	561.40	459.60	232.00	232.00	547.60	547.60	-	0.40	49.80	50.00	2,337.10	2,337.10	1,858.90	1,864.50	5.40	5.40	34,044.20	99.80
August	2018	2,471.60	2,471.60	135.50	135.50	334.00	334.00	406.60	406.60	2,735.40	2,306.90	2,648.70	2,662.50	45.10	45.10	1,238.90	1,240.50	1,047.50	1,047.50	4,634.80	4,634.80	451.60	450.50	2,512.10	2,512.10	34,814.40	2,095.00
September	2018	6,608.60	6,608.60	1,627.30	1,635.10	979.10	979.10	4,291.40	4,291.40	5,414.60	5,279.40	4,874.50	4,874.50	238.30	238.30	1,119.80	1,120.00	7,776.90	7,779.90	10,450.70	10,450.70	5,490.70	5,561.60	8,324.20	8,324.20	98,782.10	15,556.80
October	2018	2,343.50	2,343.50	366.90	366.90	359.35	359.35	666.60	666.60	1,616.25	1,616.25	343.05	343.05	134.20	134.20	42.55	42.55	1,429.65	1,429.65	3,445.30	3,445.30	-	-	1,340.50	1,340.50	21,316.40	2,859.30
November	2018	5,993.10	5,993.10	720.25	720.25	1,033.80	1,033.80	5,344.70	5,344.70	2,165.50	2,165.50	1,744.20	1,744.20	896.20	896.20	4,441.00	4,441.00	988.55	988.55	368.55	368.55	1,623.50	1,623.50	381.30	381.30	49,424.20	1,977.10
December	2018	5,535.55	5,535.55	1,612.45	1,612.45	1,819.30	1,819.30	2,774.60	2,774.60	1,072.90	1,072.90	937.60	937.60	922.05	922.05	6,410.45	6,410.45	1,878.00	1,878.00	3,504.90	3,504.90	1,351.60	1,351.60	1,007.65	1,007.65	53,898.10	3,756.00
January	2019	899.10	899.10	-	-	426.70	426.70	668.30	668.30	-	-	-	-	-	-	1,900.30	1,900.30	-	-	-	-	-	-	300.50	300.50	8,389.80	-
February	2019	738.10	738.10	-	-	-	-	-	-	-	-	-	-	-	-	894.00	894.00	-	-	-	-	368.80	368.80	-	-	4,001.80	-
March	2019	214.80	214.80	1,586.20	1,586.20	1,170.30	1,170.30	3,006.10	3,006.10	160.10	160.10	1,948.20	1,948.20	859.40	859.40	2,812.80	2,812.80	-	-	-	-	1,393.20	1,393.20	344.20	344.20	26,990.60	-
April	2019	760.40	760.40	766.05	766.05	816.65	816.65	2,412.40	2,412.40	673.60	673.60	1,309.70	1,309.70	652.20	652.20	3,993.70	3,993.70	1,053.45	1,053.45	458.00	458.00	693.75	693.75	306.15	306.15	25,685.20	2,106.90
May	2019	61.70	61.70	61.70	61.70	353.10	353.10	59.30	59.30	-	-	132.10	132.10	-	-	-	-	214.30	214.30	-	-	-	-	-	-	1,335.80	428.60
June	2019	1,654.70	1,654.70	2,645.10	2,645.10	2,003.00	2,003.00	1,427.30	1,427.30	1,052.20	1,052.20	1,302.00	1,302.00	1,023.30	1,023.30	2,222.10	2,222.10	2,785.30	2,785.30	2,762.00	2,762.00	2,186.80	2,186.80	1,665.10	1,665.10	39,887.20	5,570.60
July	2019	1,467.50	1,467.50	2,136.50	2,136.50	5,288.90	5,288.90	1,526.70	1,526.70	1,068.60	1,068.60	1,262.00	1,262.00	1,131.80	1,131.80	3,340.60	3,340.60	4,686.90	4,686.90	4,167.70	4,167.70	1,329.20	1,329.20	2,273.20	2,273.20	49,985.40	9,373.80
August	2019	721.40	721.40	1,036.00	1,036.00	1,553.10	1,553.10	798.60	798.60	565.70	565.70	735.70	735.70	536.20	536.20	995.40	995.40	1,882.30	1,882.30	1,608.40	1,608.40	905.30	905.30	757.40	757.40	20,426.40	3,764.60
September	2019	242.90	242.90	846.50	846.50	1,398.50	1,398.50	525.30	525.30	284.90	284.90	275.30	275.30	274.90	274.90	292.70	292.70	2,169.30	2,169.30	1,647.00	1,647.00	942.20	942.20	944.10	944.10	15,348.60	4,338.60
October	2019	271.30	271.30	835.60	835.60	2,056.80	2,056.80	269.50	269.50	7.80	7.80	18.65	18.65	-	-	4.46	4.46	749.65	749.65	1,633.30	1,633.30	1,375.40	1,375.40	1,047.75	1,047.75	15,041.11	1,499.30
November	2019	-	-	24.40	24.40	17.38	17.38	-	-	-	-	334.75	334.75	-	-	11.57	11.57	7.95	7.95	40.45	40.45	307.15	307.15	4.69	4.69	1,480.79	15.90
December	2019	1,685.60	1,685.60	725.75	725.75	738.90	738.90	-	-	104.80	104.80	1,893.30	1,983.30	67.00	67.00	847.70	847.70	-	-	-	-	783.10	783.10	704.20	704.20	15,190.70	-

NRG Astoria Turbine Replacement Project

Total Heat Input (MMBtu) Based on Part 75 ECMPS data submitted to USEPA

Month	Year	CT2-1A	CT2-1B	CT2-2A	CT2-2B	CT2-3A	CT2-3B	CT2-4A	CT2-4B	CT3-1A	CT3-1B	CT3-2A	CT3-2B	CT3-3A	CT3-3B	CT3-4A	CT3-4B	CT4-1A	CT4-1B	CT4-2A	CT4-2B	CT4-3A	CT4-3B	CT4-4A	CT4-4B	Monthly Total Heat Input (MMBtu)	Monthly Total Heat Input (MMBtu)
To be Removed?		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Curtailed	Curtailed	Yes	Yes	Yes	Yes	Yes	Yes	22 turbines	GT 4-1 A & B
January	2015	523.7	523.7	285.4	285.4	370.9	370.9	479.6	479.6	355.7	355.7	293.8	293.8	489	489	390.1	390.1	1296.4	1296.4	532.3	532.3	409.4	409.4	0.7	0.7	8,261.20	2,592.80
February	2015	1910.8	1910.8	387.3	387.3	719.7	719.7	2470.3	2470.3	0	0	276.6	276.6	1580.7	1580.7	294.9	294.9	4289.6	4289.6	2338.5	2338.5	143.8	143.8	0	0	20,245.20	8,579.20
March	2015	4529.8	4529.8	1689.5	1689.5	1356.6	1356.6	4858.9	4858.9	558.5	558.5	1280.9	1280.9	3326.8	3326.8	788	788	6640.6	6640.6	1707.1	1707.1	1109.6	1109.6	1458.9	1458.9	45,329.20	13,281.20
April	2015	350.8	350.8	0	0	0	0	673.6	673.6	0	0	505.9	505.9	586.2	586.2	364.9	364.9	3100.3	3100.3	1155.8	1099.6	495	495	551.2	551.2	9,310.60	6,200.60
May	2015	613.2	613.2	566.2	566.2	0	0	2.5	2.5	3487.4	3302.3	4229	4229	4728.6	4728.6	4341.1	4341.1	11634.5	11400.8	10785.8	10441.4	9593.3	9593.3	9481.5	9481.5	95,127.70	23,035.30
June	2015	1662.4	1664.5	1270.4	1223	1547	1547	1684.6	1684.6	1246.1	1118.2	1055.9	1055.9	1600.4	1600.4	1049.7	1049.7	5330.7	5336.2	3660.8	3660.8	2253.9	2253.9	2129.6	2129.6	38,148.40	10,666.90
July	2015	1344.7	1344.7	983.9	983.9	1403.6	1403.6	2379.6	2384.4	885.3	804.6	425.2	425.2	1398.9	1398.9	1039.9	1039.9	1997.1	2147.8	936.3	932	1065.4	1065.4	674.1	674.1	24,993.60	4,144.90
August	2015	3240.5	3240.5	2028.8	2028.8	953.8	954	4005.2	4005.2	1332	1264.5	1864.6	1864.6	3608.2	3608.2	1771.6	1771.6	4767.6	4767.6	2864.3	2864.3	2015.7	2015.7	1652.6	1652.6	50,607.30	9,535.20
September	2015	5687	5689.5	6820.3	6803.6	4606.5	4617.5	5934.3	5934.3	1104.7	926.9	3655.1	3655.1	1800.3	1800.3	5114.4	5114.4	4956.6	4956.6	7347.5	7347.5	5418.7	5418.7	8715	8715	112,226.60	9,913.20
October	2015	1091.6	1091.6	3316.3	3316.3	357.6	357.6	980.2	980.2	616.2	616.2	2235.5	2235.5	341.3	341.3	4072.6	4072.6	0	0	336.1	336.1	317.2	317.2	910.7	910.7	29,150.60	-
November	2015	3244.6	3231.2	5734.8	5734.8	602.6	602.6	4576.8	4576.8	60.2	60.2	2563.3	2563.3	113.9	113.9	2122	2122	791.7	791.7	2385.4	2385.4	1171.1	1171.1	2451.3	2451.3	50,038.60	1,583.40
December	2015	2484.5	2484.5	1325.8	1325.8	639	639	2612.8	2612.8	1169.7	1169.7	2354.3	2354.3	1561.4	1561.4	3368	3368	2820.5	2516	2422.5	2422.5	1684.2	1684.2	4585.4	4585.4	48,415.20	5,336.50
January	2016	701.1	701.1	358	358	0	0	656.4	656.4	0	0	0	0	657.8	657.8	59.8	59.8	987	987	370.1	370.1	431.8	431.8	0	0	6,470.00	1,974.00
February	2016	1486	1510.5	656.5	656.5	0	0	895.2	895.2	0	0	358.8	358.8	1196	1196	1554.8	1554.8	1357	1357	1233.8	1233.8	1233.7	1233.7	616.9	616.9	18,487.90	2,714.00
March	2016	328.2	393.9	477.4	477.4	358.1	358.1	1670.8	1670.8	538.2	538.2	299	299	2033.2	2033.2	478.4	478.4	3022.7	3022.7	987	987	616.8	616.8	555.1	555.1	16,750.10	6,045.40
April	2016	2402.8	2402.8	3766.4	3766.4	2143	2143	3701.6	3701.6	1664.5	1664.5	1367.3	1367.3	2258.9	2258.9	772.7	772.7	5754.6	5754.6	4855.2	4855.2	1858.1	1858.1	4975.1	4975.1	59,531.20	11,509.20
May	2016	291	291	1047.6	1047.6	291	291	1571.4	1571.4	2774.2	2774.2	2321.3	2321.3	339.7	339.7	849.3	849.3	856.8	856.8	1252.2	1252.2	1779.6	1779.6	1647.6	1647.6	28,329.80	1,713.60
June	2016	2677.2	2677.2	3259.2	3259.2	1920.6	1920.6	3375.6	3375.6	4586.4	4586.4	2208.2	2208.2	1698.5	1698.5	1925.1	1925.1	1779.8	1779.8	2109.2	2109.2	4350.1	4350.1	1779.6	1779.6	59,779.40	3,559.60
July	2016	7771.4	7771.4	9832	9832	7123.8	7123.8	7418.2	7418.2	9726.3	9726.3	10374.6	10374.6	7545.3	7545.3	5776.7	5776.7	8251.1	8251.1	9693.6	9693.6	10616.8	10616.8	8251.1	8251.1	188,259.60	16,502.20
August	2016	7712.1	7712.1	10244	10244	4415.5	4415.5	5887.2	5887.2	10020.7	10020.7	7957.7	7957.7	6543.1	6543.1	3772.4	3772.4	7443.3	7443.3	8020.3	8020.3	9174.3	9174.3	6866.3	6866.3	161,227.20	14,886.60
September	2016	529.9	529.9	1354.1	1354.1	117.7	117.7	117.7	117.7	1650.3	1650.3	1002.1	1002.1	353.6	353.6	707.3	707.3	1096.3	1096.3	634.7	634.7	750.1	750.1	634.7	634.7	15,704.40	2,192.60
October	2016	1971.9	1971.9	2748.8	2748.8	0	0	298.8	298.8	4274	4274	1675.1	1675.1	404.3	404.3	1732.6	1732.6	59.7	59.7	775.7	775.7	1730.2	1730.2	119.3	119.3	31,461.40	119.40
November	2016	1613.6	1613.6	597.7	597.7	537.9	537.9	597.7	597.7	3754.5	3754.5	2714.9	2714.9	231.2	231.2	231.2	231.2	1253.1	1253.1	2625.5	2625.5	3043.1	3043.1	1789.9	1789.9	35,474.40	2,506.20
December	2016	597.7	597.7	2450.3	2450.3	1075.7	1075.7	717.2	717.2	2888.1	2888.1	1848.4	1848.4	115.5	115.5	115.5	115.5	1074.2	1074.2	2029	2029	3699.9	3699.9	1551.5	1551.5	34,177.60	2,148.40
January	2017	664.4	664.4	2416	2416	3382.4	3382.4	1328.8	1328.8	707.7	707.7	1633.2	1633.2	707.7	707.7	489.9	489.9	652	652	2347.2	2347.2	1890.8	1890.8	1434.4	1434.4	34,005.00	1,304.00
February	2017	1147.6	1147.6	1328.8	1328.8	1268.4	1268.4	1389.2	1389.2	1197.6	1197.6	1905.4	1905.4	707.8	707.8	870.9	870.9	1173.6	1173.6	782.4	782.4	2021.2	2021.2	1043.2	1043.2	27,325.00	2,347.20
March	2017	181.2	181.2	1751.6	1751.6	1389.2	1389.2	543.6	543.6	871	871	2123.2	2123.2	3320.9	3320.9	381.1	381.1	2999.2	2999.2	1695.2	1695.2	4172.8	4172.8	1369.2	1369.2	35,598.00	5,998.40
April	2017	1765	1765	2373.5	2373.5	2738.6	2738.6	5659.7	5659.7	2856.6	2856.6	3291.3	3291.3	5030.1	5030.1	7017.3	7017.3	0	0	0	0	0	0	0	0	61,464.20	-
May	2017	3292.6	3292.6	2043.6	2043.6	3349.6	3349.6	1589.6	1589.6	2347.5	2347.5	3664.6	3664.6	572.6	572.6	3149.1	3149.1	1086.3	1086.3	1140.7	1140.7	2390.1	2390.1	2879	2879	52,838.00	2,172.60
June	2017	4825.5	4825.5	1816.8	1816.8	3236	3236	2157.4	2157.4	2977.4	2977.4	3435.5	3435.5	1546.1	1546.1	3435.4	3435.4	1901.1	1901.1	1955.4	1955.4	1846.8	1846.8	1955.6	1955.6	58,375.80	3,802.20
July	2017	4336.4	4336.4	1230.6	1230.6	1816.6	1816.6	2344	2344	1283.6	1283.6	2275.4	2275.4	875.1	875.1	2917.1	2917.1	1314.3	1314.3	711.9	711.9	1752.2	1752.2	2026	2026	43,137.80	2,628.60
August	2017	1465	1465	527.4	527.4	761.8	761.8	58.6	58.6	758.5	758.5	991.7	991.7	466.6	466.6	291.7	291.7	273.8	273.8	54.8	54.8	54.8	54.8	438.1	438.1	11,738.00	547.60
September	2017	293	293	293	293	293	293	234.4	234.4	116.7	116.7	525.1	525.1	1225.3	1225.3	350	350	711.8	711.8	1095.1	1095.1	2102.7	2102.7	383.3	383.3	13,823.20	1,423.60
October	2017	754.8	754.8	62.9	62.9	314.5	314.5	62.9	62.9	407.5	407.5	465.7	465.7	58.2	58.2	2445.4	2445.4	548.7	548.7	1463.2	1463.2	1828.9	1828.9	182.9	182.9	16,093.80	1,097.40
November	2017	1698.3	1698.3	0	0	0	0	566.1	566.1	291.1	291.1	0	0	1397.3	1397.3	582.2	582.2	61	61	122	122	1341.2	1341.2	122	122	12,240.40	122.00
December	2017	3899.8	3899.8	188.7	188.7	1069.3	1069.3	2516	2516	1106.3	1106.3	349.4	349.4	1280.9	1280.9	1048.1	1048.1	2377.4	2377.4	2987	2987	5486.1	5486.1	1828.8	1828.8	43,520.80	4,754.80
January	2018	1251.6	1251.6	658.8	658.8	856.4	856.4	922.4	922.4	337.6	337.6	337.6	337.6	618.9	618.9	337.6	337.6	680.7	680.7	1670.7	1670.7	2722.4	2722.4	371.3	371.3	20,170.60	1,361.40
February	2018	1712.6	1712.6	0	0	0	0	0	0	0	0	0	0	562.6	562.6	281.3	281.3	309.4	309.4	1237.6	1237.6	2041.7	2041.7	0	0	11,671.60	618.80
March	2018	1910.2	1910.2	131.7	131.7	131.7	131.7	197.6	197.6	225.1	225.1	618.9	618.9	900.2	900.2	506.4	506.4	494.9	494.9	1422.9	1422.9	2907.9	2907.9	0	0	17,905.20	989.80
April	2018	1627.9	1627.9	855.4	855.4	993.3	993.3	69	69	316.1	316.1	316.1	316.1	3105	3105	1580.3	1580.3	679.6	679.6	1767	1767	4629.3	4629.3	1427.1	1427.1	33,373.00	1,359.20
May	2018	6824.3	6824.3	2253	2253	4979.1	4979.1	4428.4	4428.4	2214.1	2214.1	1523.8	1523.8	1838.2	1838.2	790.5	790.5	1979.5	1979.5	3450.7	3450.7	4000.8	4000.8	2178.5	2178.5	68,962.80	3,959.00
June	2018	2580.7	2580.7	1924.9	1924.9	1364.3	1364.3	3329.2	3329.2	1623.8	1623.8	1135.7	1135.7	1976.1	1976.1	735.7	735.7	1368	1368	2689.3	2689.3	1370.4	1370.4	1620.9	1620.9	40,702.00	2,736.00
July	2018	3463.7	3463.7	1632	1640.2	2457.2	2457.2	3968.2	3973	561.4	459.6	232	232	547.6	547.6	0	0.4	49.8	50	2337.1	2337.1	1858.9	1864.5	5.4	5.4	34,044.20	99.80
August	2018	2471.6	2471.6	135.5	135.5	334	334	406.6	406.6	2735.4	2306.9	2648.7	2662.5	45.1	45.1	1238.9	1240.5	1047.5	1047.5	4634.8	4634.8	451.6	450.5	2512.1	2512.1	34,814.40	2,095.00
September	2018	6608.6	6608.6	1627.3	1635.1	979.1	979.1	4291.4	4291.4	5414.6	5279.4	4874.5	4874.5	238.3	238.3	1119.8	1120	7776.9	7779.9	10450.7	10450.7	5490.7	5561.6	8324.2	8324.2	98,782.10	15,556.80
October	2018	2343.5	2343.5	443.4	443.4	443.5	443.5	666.6	666.6	1889.1	1889.1	488.4	488.4	134.2	134.2	136.9	136.9	1493.4	1493.4	3516.7	3516.7	87.3	87.3	1411.9	1411.9	23,123.00	2,986.80
November	2018	6049.2	6049.2	784	784	1064.4	1064.4	5344.7	5344.7	2165.5	2165.5	1744.2	1744.2	896.2	896.2	4441	4441	1082.9	1082.9	401.7	401.7	1720.4	1720.4	503.7	503.7	50,230.00	2,165.80
December	2018	5905.3	5905.3	1650.7	1650.7	1839.7	1839.7	4177.1	4177.1	1837.9	1837.9	1320.1	1320.1	1623.3	1623.3	6525.2	6525.2	1878	1878	3504.9	3504.9	2116.6	2116.6	2983.9	2983.9	66,969.40	3,756.00
January	2019	899.1	899.1	0	0	426.7	426.7	668.3	668.3	0	0	0	0	0	0	1900.3	1900.3	0	0	0	0	0	0	300.5	300.5	8,389.80	-
February	2019	738.1	738.1	0	0	0	0	0	0	0	0	0	0	0	0	894	894	0	0	0	0	368.8	368.8	0	0	4,001.80	-
March	2019	214.8	214.8	1586.2	1586.2	1170.3	1170.3	3006.1	3006.1	160.1	160.1	1948.2	1948.2	859.4	859.4	2812.8	2812.8	0	0	0	0	1393.2	1393.2	344.2	344.2	26,990.60	-
April	2019	816.5	816.5	824.7	824.7	854.9	854.9	2468.5	2468.5	673.6	673.6	1309.7	1309.7	652.2	652.2	3993.7	3993.7	1117.2	1117.2	458	458	747.3	747.3	369.9	369.9	26,338.00	2,234.40
May	2019	61.7	61.7	61.7	61.7	353.1	353.1	59.3	59.3	0	0	132.1	132.1	0	0	0	0	214.3	214.3	0	0	0	0	0	0	1,335.80	428.60
June	2019	1654.7	1654.7	2645.1	2645.1	2003	2003	1427.3	1427.3	1052.2	1052.2	1302	1302	1023.3	1023.3	2222.1	2222.1	2785.3	2785.3	2762	2762	2186.8	2186.8	1665.1	1665.1	39,887.20	5,570.60
July	2019	1467.5	1467.5	2136.5	2136.5	5288.9	5288.9	1526.7	1526.7	1068.6	1068.6	1262	1262	1131.8	1131.8	3340.6	3340.6	4686.9	4686.9	4167.7	4167.7	1329.2	1329.2	2273.2	2273.2	49,985.40	9,373.80
August	2019	721.4	721.4	1036	1036	1553.1	1553.1	798.6	798.6	565.7	565.7	735.7	735.7	536.2	536.2	995.4	995.4	1882.3	1882.3	1608.4	1608.4	905.3	905.3	757.4	757.4	20,426.40	3,764.60
September	2019	242.9	242.9	846.5	846.5	1398.5	1398.5	525.3	525.3	284.9	284.9	275.3	275.3	274.9	274.9	292.7	292.7	2169.3	2169.3	1647	1647	942.2	942.2	944.1	944.1	15,348.60	4,338.60
October	2019	271.3	271.3	835.6	835.6	2056.8	2056.8	269.5	269.5	58.8	58.8	184.4	184.4	20.3	20.3	15.6	15.6	782.8	782.8	1679.2	1679.2	1400.9	1400.9	1086	1086	15,756.80	1,565.60
November	2019	48.8	48.8	55	55	44.9	44.9	56.3	56.3	47.5	47.5	383.2	383.2	42.5	42.5	56.9	56.9	66.6	66.6	165.4	165.4	416.8	416.8	70.4	70.4	2,775.40	133.20
December	2019	1685.6	1685.6	758.9	758.9	738.9	738.9	26.4	26.4	104.8	104.8	1893.3	1983.3	67	67	847.7	847.7	71.3	71.3	0	0	783.1	783.1	704.2	704.2	15,309.80	142.60

NRG Astoria Turbine Replacement Project

Kerosene PM / PM10 / PM2.5 (lbs) Based on kerosene heat input and tested emission factors

Month	Year	CT2-1A	CT2-1B	CT2-2A	CT2-2B	CT2-3A	CT2-3B	CT2-4A	CT2-4B	CT3-1A	CT3-1B	CT3-2A	CT3-2B	CT3-3A	CT3-3B	CT3-4A	CT3-4B	CT4-1A	CT4-1B	CT4-2A	CT4-2B	CT4-3A	CT4-3B	CT4-4A	CT4-4B	Monthly Kerosene PM / PM10 / PM2.5 (lbs)	Monthly Kerosene PM / PM10 / PM2.5 (lbs)
To be Removed?		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Curtailed	Curtailed	Yes	Yes	Yes	Yes	Yes	Yes	22 turbines	GT 4-1 A & B
January	2015	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
February	2015	89.33	89.33	18.11	18.11	33.65	33.65	71.53	71.53	-	-	12.93	12.93	41.52	41.52	13.79	13.79	133.10	133.10	109.32	109.32	6.72	6.72	-	-	793.78	266.20
March	2015	-	-	-	-	10.95	10.95	-	-	-	-	-	-	-	-	-	-	42.22	42.22	28.30	28.30	-	-	-	-	78.51	84.44
April	2015	-	-	-	-	-	-	-	-	-	-	10.65	10.65	-	-	-	-	-	-	-	-	-	-	-	-	21.31	-
May	2015	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
June	2015	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
July	2015	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
August	2015	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
September	2015	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
October	2015	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
November	2015	-	-	-	-	-	-	-	-	2.81	2.81	-	-	-	-	-	-	-	-	-	-	-	-	5.96	5.96	17.55	-
December	2015	5.96	5.96	5.96	5.96	2.98	2.98	11.92	11.92	2.98	2.98	2.98	2.98	5.96	5.96	2.98	2.98	5.96	5.96	5.96	5.96	-	-	-	-	95.37	11.92
January	2016	13.39	13.39	-	-	-	-	13.39	13.39	-	-	-	-	13.39	13.39	-	-	13.39	13.39	12.95	12.95	13.39	13.39	-	-	133.01	26.78
February	2016	22.31	22.31	13.39	13.39	-	-	11.16	11.16	-	-	-	-	22.31	22.31	33.47	33.47	20.08	40.16	31.24	11.16	20.08	20.08	8.93	8.93	305.68	60.24
March	2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
April	2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
May	2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
June	2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
July	2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
August	2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
September	2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
October	2016	62.48	62.48	42.39	42.39	-	-	-	-	60.24	60.24	4.46	4.46	-	-	51.32	51.32	-	-	-	-	-	-	-	-	441.79	-
November	2016	-	-	-	-	-	-	-	-	-	4.46	4.46	-	4.46	4.46	2.23	2.23	4.46	4.46	-	-	-	-	-	-	22.31	8.93
December	2016	-	-	6.69	6.69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13.39	-
January	2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.93	8.93	-	-	-	-	-	-	-	17.85
February	2017	-	-	4.46	4.46	-	-	4.46	4.46	-	-	4.46	4.46	-	-	-	-	-	-	4.46	4.46	-	-	-	-	35.70	-
March	2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
April	2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
May	2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
June	2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
July	2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
August	2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
September	2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
October	2017	2.23	2.23	2.20	2.20	4.46	4.46	-	-	2.23	2.23	4.46	4.46	2.04	2.04	6.69	6.69	2.23	2.23	2.23	2.23	4.46	4.46	2.23	2.23	66.49	4.46
November	2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
December	2017	20.08	20.08	4.46	4.46	4.46	4.46	17.85	17.85	15.62	15.62	-	-	13.39	13.39	13.39	13.39	11.16	11.16	15.62	15.62	17.85	17.85	6.69	6.69	258.83	22.31
January	2018	6.69	6.69	-	-	15.62	15.62	-	-	-	-	-	-	-	-	-	-	8.93	8.93	-	-	24.54	24.54	-	-	93.71	17.85
February	2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
March	2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
April	2018	15.80	15.80	15.62	15.62	15.62	15.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	94.07	-
May	2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
June	2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
July	2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
August	2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
September	2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
October	2018	-	-	2.68	2.68	2.95	2.95	-	-	9.55	9.55	5.09	5.09	-	-	3.30	3.30	2.23	2.23	2.50	2.50	3.06	3.06	2.50	2.50	63.23	4.46
November	2018	1.96	1.96	2.23	2.23	1.07	1.07	-	-	-	-	-	-	-	-	-	-	3.30	3.30	1.16	1.16	3.39	3.39	4.28	4.28	28.20	6.60
December	2018	12.94	12.94	1.34	1.34	0.71	0.71	49.09	49.09	26.78	26.78	13.39	13.39	24.54	24.54	4.02	4.02	-	-	-	-	26.78	26.78	69.17	69.17	457.50	-
January	2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
February	2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
March	2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
April	2019	1.96	1.96	2.05	2.05	1.34	1.34	1.96	1.96	-	-	-	-	-	-	-	-	2.23	2.23	-	-	1.87	1.87	2.23	2.23	22.85	4.46
May	2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
June	2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
July	2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
August	2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
September	2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
October	2019	-	-	-	-	-	-	-	-	1.79	1.79	5.80	5.80	0.71	0.71	0.39	0.39	1.16	1.16	1.61	1.61	0.89	0.89	1.34	1.34	25.05	2.32
November	2019	1.71	1.71	1.07	1.07	0.96	0.96	1.97	1.97	1.66	1.66	1.70	1.70	1.49	1.49	1.59	1.59	2.05	2.05	4.37	4.37	3.84	3.84	2.30	2.30	45.31	4.11
December	2019	-	-	1.16	1.16	-	-	0.92	0.92	-	-	-	-	-	-	-	-	2.50	2.50	-	-	-	-	-	-	4.17	4.99

NRG Astoria Turbine Replacement Project

SO_2 (tons) Based on Part 75 ECMPS data submitted to USEPA

Month	Year	CT2-1A	CT2-1B	CT2-2A	CT2-2B	CT2-3A	CT2-3B	CT2-4A	CT2-4B	CT3-1A	CT3-1B	CT3-2A	CT3-2B	CT3-3A	CT3-3B	CT3-4A	CT3-4B	CT4-1A	CT4-1B	CT4-2A	CT4-2B	CT4-3A	CT4-3B	CT4-4A	CT4-4B	Monthly SO2 (tons) 22 turbines	Monthly SO2 (tons) GT 4-1 A & B
	To be Removed?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Curtailed	Curtailed	Yes	Yes	Yes	Yes	Yes	Yes		
January	2015	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	-
February	2015	0.308	0.308	0.097	0.097	0.18	0.18	0.185	0.185	0	0	0.069	0.069	0.238	0.238	0.074	0.074	0.554	0.554	0.482	0.482	0.036	0.036	0	0	3.34	1.11
March	2015	0.001	0.001	0	0	0.029	0.029	0.076	0.076	0	0	0	0	0.001	0.001	0.001	0.001	0.094	0.094	0.081	0.081	0	0	0	0	0.38	0.19
April	2015	0	0	0	0	0	0	0	0	0	0	0.037	0.037	0	0	0	0	0.001	0.001	0	0	0	0	0	0	0.07	0.00
May	2015	0	0	0	0	0	0	0	0	0.001	0.001	0.001	0.001	0.002	0.002	0.001	0.001	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.03	0.01
June	2015	0.001	0.001	0	0	0	0	0.001	0.001	0	0	0	0	0	0	0	0	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.01	0.00
July	2015	0	0	0	0	0	0	0.001	0.001	0	0	0	0	0	0	0	0	0.001	0.001	0	0	0	0	0	0	0.00	0.00
August	2015	0.001	0.001	0.001	0.001	0	0	0.001	0.001	0	0	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.02	0.00
September	2015	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0	0	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.003	0.003	0.002	0.002	0.003	0.003	0.04	0.00
October	2015	0	0	0.001	0.001	0	0	0	0	0	0	0.001	0.001	0	0	0.001	0.001	0	0	0	0	0	0	0	0	0.01	-
November	2015	0.001	0.001	0.002	0.002	0	0	0.001	0.001	0.012	0.012	0.001	0.001	0	0	0.001	0.001	0	0	0.001	0.001	0	0	0.013	0.013	0.06	-
December	2015	0.019	0.019	0.006	0.006	0.008	0.008	0.092	0.092	0.006	0.006	0.008	0.008	0.006	0.006	0.011	0.011	0.009	0.009	0.011	0.011	0.005	0.005	0.001	0.001	0.35	0.02
January	2016	0.096	0.096	0.09	0.09	0	0	0.09	0.09	0	0	0	0	0.09	0.09	0	0	0.093	0.093	0.093	0.093	0.093	0.093	0	0	1.10	0.19
February	2016	0.135	0.144	0.09	0.09	0	0	0.075	0.075	0	0	0	0	0.15	0.15	0.224	0.224	0.139	0.139	0.216	0.216	0.154	0.154	0.062	0.062	2.22	0.28
March	2016	0	0	0	0	0	0	0	0	0	0	0	0	0.06	0.06	0	0	0.001	0.001	0	0	0	0	0	0	0.12	0.00
April	2016	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0	0	0	0	0.001	0.001	0	0	0.002	0.002	0.001	0.001	0	0	0.001	0.001	0.01	0.00
May	2016	0	0	0	0	0	0	0	0	0.001	0.001	0.001	0.001	0	0	0	0	0	0	0	0	0.001	0.001	0.001	0.001	0.01	-
June	2016	0.001	0.001	0.001	0.001	0	0	0.001	0.001	0.001	0.001	0.001	0.001	0	0	0	0	0.001	0.001	0.001	0.001	0.001	0.001	0	0	0.01	0.00
July	2016	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.001	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.04	0.00
August	2016	0.002	0.002	0.002	0.002	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.001	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.04	0.00
September	2016	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	-
October	2016	0.418	0.418	0.359	0.359	0	0	0	0	0.391	0.391	0.029	0.029	0	0	0.332	0.332	0	0	0	0	0.001	0.001	0	0	3.06	-
November	2016	0	0	0	0	0	0	0	0	0.03	0.03	0.001	0.001	0.029	0.029	0.014	0.014	0.015	0.015	0.001	0.001	0.001	0.001	0.016	0.016	0.18	0.03
December	2016	0	0	0.045	0.045	0	0	0	0	0.001	0.001	0.001	0.001	0	0	0	0	0	0	0	0	0.001	0.001	0	0	0.10	-
January	2017	0	0	0.001	0.001	0.001	0.001	0	0	0	0	0	0	0	0	0	0	0.065	0.065	0.001	0.001	0.001	0.001	0	0	0.01	0.13
February	2017	0	0	0	0	0	0	0.031	0.031	0	0	0.028	0.028	0	0	0	0	0	0	0.033	0.033	0.001	0.001	0	0	0.19	-
March	2017	0	0	0	0	0	0	0	0	0	0	0.001	0.001	0.001	0.001	0	0	0.001	0.001	0.001	0.001	0.001	0.001	0	0	0.01	0.00
April	2017	0	0	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0	0	0	0	0	0	0	0	0.01	-
May	2017	0.001	0.001	0.001	0.001	0.001	0.001	0	0	0.001	0.001	0.001	0.001	0	0	0.001	0.001	0	0	0	0	0.001	0.001	0.001	0.001	0.02	-
June	2017	0.001	0.001	0	0	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0	0	0.001	0.001	0.001	0.001	0.001	0.001	0	0	0.001	0.001	0.02	0.00
July	2017	0.001	0.001	0	0	0	0	0.001	0.001	0	0	0.001	0.001	0	0	0.001	0.001	0	0	0	0	0	0	0	0	0.01	-
August	2017	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	-
September	2017	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	-
October	2017	0.016	0.016	0.016	0.016	0.032	0.032	0.016	0.016	0.015	0.015	0.029	0.029	0.015	0.015	0.044	0.044	0.015	0.015	0.016	0.016	0.031	0.031	0	0	0.46	0.03
November	2017	0.001	0.001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	-
December	2017	0.143	0.143	0.032	0.032	0.032	0.032	0.127	0.127	0.029	0.029	0.015	0.015	0.102	0.102	0.102	0.102	0.077	0.077	0.107	0.107	0.123	0.123	0.046	0.046	1.72	0.15
January	2018	0.05	0.05	0	0	0.115	0.115	0	0	0	0	0	0	0	0	0	0	0.062	0.062	0	0	0.171	0.171	0	0	0.67	0.12
February	2018	0.001	0.001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.001	0.001	0	0	0.00	-
March	2018	0.001	0.001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.001	0.001	0	0	0.00	-
April	2018	0.123	0.123	0.086	0.086	0.121	0.121	0	0	0	0	0	0	0.001	0.001	0.001	0.001	0	0	0.001	0.001	0.001	0.001	0	0	0.67	-
May	2018	0.002	0.002	0.001	0.001	0.002	0.002	0.002	0.002	0.001	0.001	0	0	0	0	0	0	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.02	0.00
June	2018	0.001	0.001	0.001	0.001	0	0	0.001	0.001	0	0	0	0	0	0	0	0	0	0	0.001	0.001	0	0	0	0	0.01	-
July	2018	0.001	0.001	0	0	0.001	0.001	0.001	0.001	0	0	0	0	0	0	0	0	0	0	0.001	0.001	0	0	0	0	0.01	-
August	2018	0.001	0.001	0	0	0	0	0	0	0.001	0.001	0.001	0.001	0	0	0	0	0	0	0.001	0.001	0	0	0.001	0.001	0.01	-
September	2018	0.002	0.002	0	0	0	0	0.001	0.001	0.001	0.001	0.002	0.002	0	0	0	0	0.002	0.002	0.003	0.003	0.002	0.002	0.002	0.002	0.03	0.00
October	2018	0.001	0.001	0.022	0.022	0.024	0.024	0	0	0.072	0.072	0.038	0.038	0	0	0.025	0.025	0.019	0.019	0.167	0.167	0.022	0.022	0.021	0.021	0.78	0.04
November	2018	0.018	0.018	0.018	0.018	0.009	0.009	0.002	0.002	0.001	0.001	0.001	0.001	0	0	0.001	0.001	0.027	0.027	0.082	0.082	0.028	0.028	0.035	0.035	0.39	0.05
December	2018	0.106	0.106	0.033	0.033	0.017	0.017	0.394	0.394	0.202	0.202	0.101	0.101	0.185	0.185	0.569	0.569	0.001	0.001	0.728	0.728	0.219	0.219	0.564	0.564	6.24	0.00
January	2019	0.034	0.034	0	0	0.107	0.107	0.09	0.09	0	0	0	0	0	0	0.001	0.001	0	0	0	0	0	0	0	0.075	0.54	-
February	2019	0.017	0.017	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.03	-
March	2019	0	0	0	0	0	0	0.001	0.001	0	0	0.001	0.001	0	0	0.001	0.001	0	0	0	0	0	0	0	0	0.01	-
April	2019	0.015	0.015	0	0	0	0	0.016	0.016	0	0	0	0	0	0	0.001	0.001	0.016	0.016	0	0	0.013	0.013	0.016	0.016	0.12	0.03
May	2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	-
June	2019	0	0	0.001	0.001	0.001	0.001	0	0	0	0	0	0	0	0	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0	0	0.01	0.00
July	2019	0	0	0.001	0.001	0.002	0.002	0	0	0	0	0	0	0	0	0.001	0.001	0.001	0.001	0.001	0.001	0	0	0.001	0.001	0.01	0.00
August	2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.001	0.001	0.001	0.001	0	0	0	0	0.00	0.00
September	2019	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.001	0.001	0.001	0.001	0	0	0	0	0.00	0.00
October	2019	0	0	0	0	0	0	0	0	0.006	0.006	0.019	0.019	0.005	0.005	0.004	0.004	0.003	0.003	0.002	0.002	0.002	0.002	0.004	0.004	0.08	0.01
November	2019	0.012	0.012	0.009	0.009	0.003	0.003	0	0	0.012	0.012	0.012	0.012	0.011	0.011	0.013	0.013	0.013	0.013	0.017	0.017	0.019	0.019	0.015	0.015	0.25	0.03
December	2019	0	0	0.002	0.002	0.083	0.083	0.007	0.007	0	0	0	0	0	0	0	0	0.018	0.018	0	0	0	0	0	0	0.18	0.04

NRG Astoria Turbine Replacement Project

NOx (tons), uncorrected Based on Part 75 ECMPS data submitted to USEPA

Month	Year	CT2-1A	CT2-1B	CT2-2A	CT2-2B	CT2-3A	CT2-3B	CT2-4A	CT2-4B	CT3-1A	CT3-1B	CT3-2A	CT3-2B	CT3-3A	CT3-3B	CT3-4A	CT3-4B	CT4-1A	CT4-1B	CT4-2A	CT4-2B	CT4-3A	CT4-3B	CT4-4A	CT4-4B	Monthly NOx (tons), uncorrected	Monthly NOx (tons), uncorrected
To be Removed?		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Curtailed	Curtailed	Yes	Yes	Yes	Yes	Yes	Yes	22 turbines	GT 4-1 A & B
January	2015	0.122	0.133	0.067	0.072	0.086	0.094	0.112	0.122	0.083	0.09	0.068	0.075	0.114	0.124	0.091	0.099	0.302	0.329	0.124	0.135	0.095	0.104	0	0	2.01	0.63
February	2015	0.717	0.816	0.176	0.203	0.326	0.376	0.738	0.825	0	0	0.125	0.145	0.578	0.657	0.134	0.154	1.487	1.684	0.97	1.113	0.065	0.075	0	0	8.19	3.17
March	2015	1.056	1.148	0.394	0.428	0.341	0.374	1.198	1.312	0.13	0.142	0.298	0.325	0.775	0.843	0.184	0.201	1.628	1.782	0.469	0.519	0.259	0.281	0.34	0.37	11.39	3.41
April	2015	0.082	0.089	0	0	0	0	0.157	0.171	0	0	0.151	0.168	0.137	0.149	0.085	0.093	0.722	0.786	0.269	0.279	0.115	0.125	0.128	0.14	2.34	1.51
May	2015	0.143	0.155	0.132	0.144	0	0	0.001	0.001	0.813	0.837	0.985	1.072	1.102	1.199	1.011	1.1	2.711	2.89	2.513	2.647	2.235	2.432	2.209	2.403	23.13	5.60
June	2015	0.387	0.422	0.296	0.31	0.36	0.392	0.392	0.427	0.29	0.283	0.246	0.268	0.373	0.406	0.245	0.266	1.242	1.353	0.853	0.928	0.525	0.571	0.496	0.54	9.28	2.60
July	2015	0.313	0.341	0.229	0.249	0.327	0.356	0.554	0.605	0.206	0.204	0.099	0.108	0.326	0.355	0.242	0.264	0.465	0.545	0.218	0.236	0.248	0.27	0.157	0.171	6.08	1.01
August	2015	0.755	0.821	0.473	0.514	0.222	0.242	0.933	1.015	0.31	0.321	0.435	0.473	0.841	0.915	0.413	0.449	1.111	1.209	0.668	0.726	0.47	0.511	0.385	0.419	12.31	2.32
September	2015	1.325	1.442	1.589	1.725	1.073	1.171	1.382	1.504	0.257	0.235	0.852	0.926	0.42	0.456	1.191	1.296	1.155	1.256	1.712	1.862	1.263	1.374	2.031	2.209	27.30	2.41
October	2015	0.254	0.277	0.773	0.841	0.083	0.091	0.228	0.249	0.144	0.156	0.521	0.567	0.08	0.087	0.949	1.032	0	0	0.078	0.085	0.074	0.08	0.212	0.231	7.09	-
November	2015	0.756	0.819	1.336	1.454	0.14	0.153	1.066	1.161	0.025	0.028	0.597	0.65	0.027	0.029	0.494	0.538	0.185	0.201	0.556	0.605	0.273	0.297	0.582	0.635	12.22	0.39
December	2015	0.595	0.65	0.314	0.342	0.155	0.17	0.69	0.761	0.278	0.303	0.555	0.604	0.369	0.401	0.793	0.865	0.665	0.647	0.574	0.626	0.397	0.432	1.068	1.163	12.11	1.31
January	2016	0.248	0.281	0.162	0.187	0	0	0.232	0.263	0	0	0	0	0.232	0.263	0.014	0.015	0.312	0.35	0.168	0.194	0.182	0.209	0	0	2.65	0.66
February	2016	0.465	0.538	0.232	0.263	0	0	0.274	0.307	0	0	0.084	0.091	0.411	0.464	0.56	0.636	0.439	0.494	0.478	0.546	0.424	0.479	0.198	0.223	6.67	0.93
March	2016	0.077	0.1	0.111	0.121	0.083	0.091	0.389	0.424	0.125	0.136	0.07	0.076	0.527	0.58	0.112	0.121	0.705	0.766	0.23	0.25	0.144	0.156	0.129	0.141	4.19	1.47
April	2016	0.591	0.587	0.926	0.921	0.527	0.524	0.91	0.905	0.391	0.419	0.319	0.347	0.538	0.565	0.184	0.193	1.344	1.41	1.089	1.158	0.449	0.46	1.217	1.221	14.44	2.75
May	2016	0.072	0.071	0.258	0.256	0.072	0.071	0.387	0.384	0.673	0.679	0.571	0.56	0.084	0.083	0.209	0.208	0.201	0.2	0.274	0.286	0.438	0.435	0.405	0.403	6.88	0.40
June	2016	0.658	0.655	0.802	0.797	0.472	0.47	0.83	0.825	1.113	1.122	0.543	0.532	0.418	0.416	0.473	0.471	0.417	0.416	0.461	0.482	1.07	1.064	0.438	0.435	14.55	0.83
July	2016	1.912	1.901	2.419	2.405	1.753	1.742	1.825	1.814	2.359	2.378	2.552	2.501	1.856	1.845	1.421	1.412	1.934	1.927	2.119	2.215	2.613	2.596	2.031	2.018	45.69	3.86
August	2016	1.898	1.886	2.521	2.506	1.087	1.08	1.449	1.44	2.431	2.45	1.958	1.918	1.61	1.6	0.928	0.923	1.745	1.738	1.753	1.833	2.258	2.243	1.69	1.679	39.14	3.48
September	2016	0.13	0.13	0.333	0.331	0.029	0.029	0.029	0.029	0.4	0.404	0.247	0.242	0.087	0.086	0.174	0.173	0.257	0.256	0.139	0.145	0.185	0.183	0.156	0.155	3.82	0.51
October	2016	0.82	0.869	0.974	1.008	0	0	0.074	0.073	1.358	1.434	0.436	0.436	0.099	0.099	0.695	0.774	0.014	0.014	0.169	0.177	0.426	0.423	0.029	0.029	10.40	0.03
November	2016	0.397	0.394	0.147	0.146	0.132	0.132	0.147	0.146	0.933	0.94	0.668	0.654	0.079	0.084	0.068	0.071	0.306	0.308	0.574	0.6	0.749	0.744	0.452	0.452	8.71	0.61
December	2016	0.147	0.146	0.64	0.628	0.265	0.263	0.176	0.175	0.7	0.706	0.455	0.446	0.028	0.028	0.028	0.028	0.252	0.251	0.443	0.464	0.91	0.904	0.382	0.379	8.34	0.50
January	2017	0.163	0.162	0.594	0.591	0.832	0.827	0.327	0.325	0.172	0.173	0.402	0.394	0.174	0.173	0.121	0.12	0.207	0.218	0.513	0.536	0.465	0.462	0.353	0.351	8.23	0.43
February	2017	0.282	0.281	0.327	0.325	0.312	0.31	0.365	0.369	0.29	0.293	0.49	0.486	0.174	0.173	0.214	0.213	0.275	0.274	0.2	0.212	0.497	0.494	0.257	0.255	6.82	0.55
March	2017	0.045	0.044	0.431	0.428	0.342	0.34	0.134	0.133	0.211	0.213	0.523	0.512	0.817	0.812	0.094	0.093	0.703	0.7	0.371	0.387	1.027	1.02	0.337	0.335	8.65	1.40
April	2017	0.434	0.432	0.584	0.58	0.674	0.67	1.393	1.384	0.693	0.699	0.81	0.793	1.238	1.23	1.727	1.716	0	0	0	0	0	0	0	0	15.06	-
May	2017	0.81	0.805	0.503	0.5	0.824	0.819	0.391	0.389	0.569	0.574	0.902	0.883	0.141	0.14	0.775	0.77	0.255	0.254	0.249	0.261	0.588	0.585	0.708	0.704	12.89	0.51
June	2017	1.187	1.18	0.447	0.444	0.796	0.792	0.53	0.528	0.722	0.728	0.845	0.828	0.38	0.378	0.845	0.84	0.446	0.444	0.427	0.447	0.454	0.452	0.481	0.478	14.21	0.89
July	2017	1.067	1.06	0.303	0.301	0.447	0.444	0.577	0.573	0.311	0.314	0.56	0.548	0.215	0.214	0.718	0.713	0.308	0.307	0.156	0.163	0.431	0.428	0.498	0.495	10.54	0.62
August	2017	0.36	0.358	0.13	0.129	0.187	0.186	0.014	0.014	0.184	0.185	0.244	0.239	0.115	0.114	0.072	0.071	0.064	0.064	0.012	0.013	0.014	0.013	0.108	0.107	2.87	0.13
September	2017	0.072	0.072	0.072	0.072	0.072	0.072	0.058	0.057	0.028	0.029	0.129	0.127	0.301	0.3	0.086	0.086	0.167	0.166	0.239	0.25	0.517	0.514	0.094	0.094	3.34	0.33
October	2017	0.197	0.193	0.025	0.025	0.102	0.107	0.028	0.031	0.11	0.111	0.137	0.141	0.026	0.028	0.635	0.64	0.141	0.144	0.333	0.35	0.474	0.476	0.045	0.045	4.26	0.29
November	2017	0.418	0.415	0	0	0	0	0.139	0.139	0.071	0.071	0	0	0.344	0.342	0.143	0.142	0.014	0.014	0.027	0.028	0.33	0.328	0.03	0.03	3.00	0.03
December	2017	1.063	1.027	0.066	0.066	0.287	0.292	0.717	0.736	0.291	0.293	0.097	0.098	0.394	0.411	0.337	0.354	0.62	0.632	0.747	0.792	1.444	1.458	0.485	0.491	11.95	1.25
January	2018	0.344	0.332	0.162	0.161	0.3	0.32	0.227	0.226	0.082	0.083	0.083	0.081	0.152	0.151	0.083	0.083	0.21	0.221	0.365	0.382	0.802	0.829	0.091	0.091	5.43	0.43
February	2018	0.421	0.419	0	0	0	0	0	0	0	0	0	0	0.138	0.138	0.069	0.069	0.073	0.072	0.271	0.283	0.502	0.499	0	0	2.81	0.15
March	2018	0.47	0.467	0.032	0.032	0.032	0.032	0.049	0.048	0.055	0.055	0.152	0.149	0.221	0.22	0.125	0.124	0.116	0.116	0.311	0.325	0.716	0.711	0	0	4.33	0.23
April	2018	0.49	0.462	0.265	0.265	0.338	0.359	0.017	0.017	0.077	0.077	0.078	0.076	0.764	0.759	0.389	0.386	0.159	0.159	0.386	0.404	1.139	1.132	0.351	0.349	8.58	0.32
May	2018	1.679	1.668	0.554	0.551	1.225	1.217	1.089	1.083	0.537	0.541	0.375	0.367	0.452	0.449	0.194	0.193	0.464	0.462	0.754	0.788	0.984	0.978	0.536	0.533	16.75	0.93
June	2018	0.635	0.631	0.473	0.471	0.336	0.334	0.819	0.814	0.394	0.397	0.279	0.274	0.486	0.483	0.181	0.18	0.321	0.319	0.588	0.614	0.337	0.335	0.399	0.396	9.86	0.64
July	2018	0.852	0.847	0.402	0.401	0.605	0.601	0.976	0.971	0.136	0.112	0.057	0.056	0.135	0.134	0	0	0.012	0.012	0.511	0.534	0.457	0.456	0.001	0.001	8.25	0.02
August	2018	0.608	0.604	0.033	0.033	0.082	0.082	0.1	0.099	0.663	0.564	0.651	0.642	0.011	0.011	0.305	0.303	0.246	0.245	1.013	1.059	0.111	0.11	0.618	0.614	8.32	0.49
September	2018	1.626	1.616	0.4	0.4	0.241	0.239	1.056	1.049	1.313	1.291	1.199	1.175	0.059	0.058	0.275	0.274	1.824	1.817	2.283	2.388	1.351	1.36	2.048	2.035	23.74	3.64
October	2018	0.577	0.573	0.123	0.122	0.127	0.131	0.164	0.163	0.515	0.517	0.15	0.155	0.033	0.033	0.053	0.057	0.365	0.367	0.915	0.974	0.038	0.042	0.363	0.365	6.19	0.73
November	2018	1.5	1.487	0.204	0.203	0.269	0.269	1.315	1.307	0.525	0.53	0.429	0.42	0.22	0.219	1.092	1.086	0.276	0.28	0.161	0.176	0.445	0.447	0.151	0.157	12.61	0.56
December	2018	1.529	1.498	0.427	0.424	0.465	0.466	1.333	1.4	0.605	0.603	0.403	0.416	0.542	0.574	2.045	2.141	0.44	0.439	1.411	1.548	0.69	0.728	1.172	1.272	21.69	0.88
January	2019	0.246	0.237	0	0	0.188	0.207	0.234	0.25	0	0	0	0	0	0	0.467	0.465	0	0	0	0	0	0	0.074	0.146	2.51	-
February	2019	0.194	0.189	0	0	0	0	0	0	0	0	0	0	0	0	0.22	0.219	0	0	0	0	0.091	0.09	0	0	1.00	-
March	2019	0.053	0.053	0.39	0.388	0.288	0.286	0.74	0.735	0.039	0.039	0.479	0.469	0.211	0.21	0.692	0.688	0	0	0	0	0.343	0.341	0.085	0.084	6.61	-
April	2019	0.212	0.208	0.203	0.202	0.21	0.209	0.619	0.618	0.163	0.165	0.322	0.316	0.16	0.159	0.983	0.976	0.275	0.277	0.1	0.105	0.194	0.195	0.103	0.106	6.53	0.55
May	2019	0.015	0.015	0.015	0.015	0.087	0.086	0.015	0.015	0	0	0.033	0.032	0	0	0	0	0.05	0.05	0	0	0	0	0	0	0.33	0.10
June	2019	0.407	0.405	0.651	0.647	0.493	0.49	0.351	0.349	0.255	0.257	0.32	0.314	0.252	0.25	0.547	0.543	0.653	0.651	0.604	0.631	0.538	0.535	0.41	0.407	9.66	1.30
July	2019	0.361	0.359	0.525	0.522	1.301	1.293	0.375	0.373	0.259	0.261	0.31	0.304	0.278	0.277	0.822	0.817	1.099	1.095	0.911	0.952	0.327	0.325	0.559	0.556	12.07	2.19
August	2019	0.178	0.176	0.255	0.253	0.382	0.38	0.197	0.195	0.137	0.138	0.181	0.177	0.132	0.131	0.245	0.243	0.441	0.439	0.351	0.368	0.223	0.221	0.186	0.185	4.93	0.88
September	2019	0.06	0.059	0.208	0.207	0.344	0.342	0.129	0.128	0.069	0.07	0.068	0.066	0.068	0.067	0.072	0.072	0.509	0.506	0.36	0.376	0.232	0.23	0.232	0.231	3.69	1.02
October	2019	0.067	0.066	0.42	0.417	0.506	0.503	0.066	0.066	0.02	0.02	0.06	0.063	0.009	0.009	0.007	0.007	0.186	0.185	0.37	0.386	0.348	0.347	0.27	0.27	4.30	0.37
November	2019	0.021	0.018	0.019	0.019	0.013	0.014	0.014	0.014	0.021	0.021	0.103	0.105	0.019	0.021	0.025	0.026	0.026	0.029	0.05	0.055	0.117	0.12	0.03	0.033	0.88	0.06
December	2019	0.414	0.412	0.188	0.186	0.246	0.26	0.012	0.013	0.025	0.026	0.465	0.456	0.016	0.016	0.209	0.207	0.031	0.035	0	0	0.193	0.191	0.174	0.172	3.88	0.07

NRG Astoria Turbine Replacement Project

ECMPS Unit ID	CT2-1A	CT2-1B	CT2-2A	CT2-2B	CT2-3A	CT2-3B	CT2-4A	CT2-4B	CT3-1A	CT3-1B	CT3-2A	CT3-2B	CT3-3A	CT3-3B	CT3-4A	CT3-4B	CT4-1A	CT4-1B	CT4-2A	CT4-2B	CT4-3A	CT4-3B	CT4-4A	CT4-4B		
P&W Turbine Source	GT21A	GT21B	GT22A	GT22B	GT23A	GT23B	GT24A	GT24B	GT31A	GT31B	GT32A	GT32B	GT33A	GT33B	GT34A	GT34B	*GT41A*	*GT41B*	GT42A	GT42B	GT43A	GT43B	GT44A	GT44B		
ERC Method of Reduction	Future Shutdown	Future Shutdown	Future Shutdown	Future Shutdown	Future Shutdown	Future Shutdown	Future Shutdown	Future Shutdown	Future Shutdown	Future Shutdown	Future Shutdown	Future Shutdown	Future Shutdown	Future Shutdown	Future Shutdown	Future Shutdown	Curtailment	Cutrtailment	Future Shutdown	Future Shutdown	Future Shutdown	Future Shutdown	Future Shutdown	Future Shutdown		
ERC Baseline Period May 2015 - April 2017																										
Uncorrected NOx baseline emissions																										
total tons NOx	6.43	6.70	8.30	8.54	4.47	4.56	7.09	7.36	7.09	7.21	7.21	7.33	5.96	6.17	6.18	6.49	8.32	8.71	8.08	8.60	8.66	8.92	7.61	7.92		
																									22 retired turbine totals	2 curtailed turbine totals
Natural Gas MMBtu	24,138.55	24,179.25	32,334.20	32,302.15	18,404.13	18,409.73	28,460.68	28,463.08	27,783.25	27,400.00	29,508.58	29,572.33	23,510.80	23,510.80	23,532.15	23,532.15	*34,296*	*33,819*	34,316.10	34,428.63	34,966.28	34,966.28	31,425.80	31,425.80	**616,571**	**68,115**
Kerosene MMBtu	1,466.25	1,466.25	1,020.00	1,020.00	31.88	31.88	541.88	541.88	922.60	986.35	223.13	159.38	637.50	637.50	1,275.00	1,275.00	*733*	*1,020*	758.80	471.93	478.13	478.13	191.25	191.25	**14,806**	**1,753**
0.368 lb/MMBtu Natural Gas NOx RACT factor																										
lbs NOx from NG	8,883	8,898	11,899	11,887	6,773	6,775	10,474	10,474	10,224	10,083	10,859	10,883	8,652	8,652	8,660	8,660	12,621	12,445	12,628	12,670	12,868	12,868	11,565	11,565		
0.368 lb/MMBtu Kerosene NOx RACT factor																										
lbs NOx from kerosene	540	540	375	375	12	12	199	199	340	363	82	59	235	235	469	469	270	375	279	174	176	176	70	70		
NOx ERCs corrected for NOx RACT																									22 retired turbine NOx ERCs	
total lbs NOx	9,423	9,438	12,274	12,263	6,784	6,787	10,673	10,674	10,564	10,446	10,941	10,941	8,887	8,887	9,129	9,129	12,891	12,821	12,908	12,843	13,044	13,044	11,635	11,635	**232,347 lbs NOx**	
total tons NOx	4.71	4.72	6.14	6.13	3.39	3.39	5.34	5.34	5.28	5.22	5.47	5.47	4.44	4.44	4.56	4.56	6.45	6.41	6.45	6.42	6.52	6.52	5.82	5.82	**116.17 tons NOx**	
Curtailed Turbines Future NOx Emissions																									2 curtailed turbine future NOx	
total lbs NOx																	2990	2990							**5,979 lbs NOx**	
total tons NOx																	1.49	1.49							**2.99 tons NOx**	
Curtailed Turbines NOx ERCs																									2 curtailed turbine NOx ERCs	
total lbs NOx																	9901	9831							**19,732 lbs NOx**	
total tons NOx																	4.95	4.92							**9.87 tons NOx**	
0.0021 lb/MMBtu Natural Gas VOC factor																										
lbs VOC from NG	50.7	50.8	67.9	67.8	38.6	38.7	59.8	59.8	58.3	57.5	62.0	62.1	49.4	49.4	49.4	49.4	72.0	71.0	72.1	72.3	73.4	73.4	66.0	66.0		
0.00041 lb/MMBtu Kerosene VOC Factor																										
lbs VOC from kerosene	0.6	0.6	0.4	0.4	0.0	0.0	0.2	0.2	0.4	0.4	0.1	0.1	0.3	0.3	0.5	0.5	0.3	0.4	0.3	0.2	0.2	0.2	0.1	0.1		
VOC ERCs Generated																									22 retired turbine totals	
total lbs VOC	51	51	68	68	39	39	60	60	59	58	62	62	50	50	50	50	72	71	72	72	74	74	66	66	**1,301 lbs VOC**	
total tons VOC	0.03	0.03	0.03	0.03	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.03	**0.65 tons VOC**	
Curtailed Turbines Future VOC Emissions																									2 curtailed turbine future VOC	
total lbs VOC																	6	6							**13 lbs VOC**	
total tons VOC																	0.00	0.00							**0.01 tons VOC**	
Curtailed Turbines VOC ERCs																									2 curtailed turbine VOC ERCs	
total lbs VOC																	66	65							**131 lbs VOC**	
total tons VOC																	0.03	0.03							**0.07 tons VOC**	

Use of ERCs as part of proposed Project

P&W Turbine Source	GT21A	GT21B	GT22A	GT22B	GT23A	GT23B	GT24A	GT24B	GT31A	GT31B	GT32A	GT32B	GT33A	GT33B	GT34A	GT34B	*GT41A*	*GT41B*	GT42A	GT42B	GT43A	GT43B	GT44A	GT44B	**Use of NOx ERC Total**
total lbs NOx	-	-	-	-	-	-	10,673	10,674	10,564	-	-	10,941	8,887	-	9,129	9,129	-	-	12,908	12,843	13,044	13,044	11,635	11,635	**145,105 lbs NOx**
total tons NOx	-	-	-	-	-	-	5.34	5.34	5.28	-	-	5.47	4.44	-	4.56	4.56	-	-	6.45	6.42	6.52	6.52	5.82	5.82	**72.55 tons NOx**

P&W Turbine Source	GT21A	GT21B	GT22A	GT22B	GT23A	GT23B	GT24A	GT24B	GT31A	GT31B	GT32A	GT32B	GT33A	GT33B	GT34A	GT34B	*GT41A*	*GT41B*	GT42A	GT42B	GT43A	GT43B	GT44A	GT44B	**Use of VOC ERC Total**
total lbs VOC	51	51	68	68	39	39	-	60	-	-	62	62	-	49.63	49.94	49.94	-	-	72	72	-	74	66	66	**1,001 lbs VOC**
total tons VOC	0.03	0.03	0.03	0.03	0.02	0.02	-	0.03	-	-	0.03	0.03	-	0.02	0.02	0.02	-	-	0.04	0.04	-	0.04	0.03	0.03	**0.50 tons VOC**

Attachment A-6

ERCs Quantification Signed

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Division of Air Resources, Bureau of Stationary Sources
625 Broadway, Albany, New York 12233-3254
P: (518) 402-8403 | F: (518) 402-9035
www.dec.ny.gov

Emission Source ID#s
GT21A, GT21B, GT22A, GT22B,
GT23A, GT23B, GT24A, GT24B,
GT31A, GT31B, GT32A, GT32B,
GT33A, GT33B, GT34A, GT34B,
GT41A, GT41B, GT42A, GT42B,
GT43A, GT43B, GT44A, GT44B

EMISSION REDUCTION CREDIT (ERC) QUANTIFICATION FORM

(Use This Form For Part 231 Nonattainment Contaminants Only)

(NOTE: NO_x, VOC & PM-10 EMISSION REDUCTIONS PRIOR TO 11/15/90 CANNOT BE APPROVED)

Name of Facility Creating ERC(s): Astoria Gas Turbine Power

Address: 31-01 20th Avenue Astoria, NY 11105

DEC ID#: 2-6301-00191 Emission Source ID#: See list above

Contact Name: Elizabeth Vaccaro Title: EHS Specialist Phone #: 718-429-0022

NOTE: Contact name and phone number will be entered into the NYS ERC Registry which is available on DEC's website.

I Andrew Scano (print name of facility's authorized representative) **certify that the information contained herein is true to the best of my knowledge, information and belief.**

Signature: Andrew Scano Title: Plant Manager Date: 4 / 23 / 2020

Reduction Type (check one box): ☐ **Past** ☒ **Future* (Note: Must be linked to proposed major facility or modification to be eligible for approval – Ref: 231-10.1(o))**

***Provide The Following Information For The Facility Proposing To Use The Future ERC(s):**

Facility Name: Astoria Gas Turbine Power DEC ID#: 2-6301-00191

Address: 31-01 20th Avenue Astoria, NY 11105

Preparer's Name: ______ Title: ______

FOR DEC USE ONLY

Approved ERCs

VOC: ______TPY NO_x: ______TPY Permit Number: ______

PM-10: ______TPY ENB Notice Date: / /

Reviewer's Name: ______ Permit Mod Issuance Date: / /

Signature: ______ Permit Surrender Date: / /

Date: / / ERC Approval Letter Date: / /

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

Determination of the Baseline Period for the reduction(s)

A.1 Emission Reduction Nonattainment Contaminant (circle **all** that apply to a specific emission reduction action at an emission source):

NO_x VOC PM-10

A.2 Emission Reduction Date: June / 1 / 2023

NOTE: The emission reduction date is the date that the emission reduction(s) physically occurred (past reduction), or the date the reduction(s) is/are scheduled to occur (future reduction).

A.3 Describe action(s) taken (or to be taken) to reduce emissions for which ERC(s) is/are requested:

Physical shutdown and decommissioning of 22 Pratt & Whitney combustion turbines.

Curtailment of operation of 2 Pratt & Whitney combustion turbines to 12 hours per year.

A.4 Baseline Period (231-4.1(b)(7)) for the emission reduction(s): May / 1 /2015 to Apr / 30 / 2017

Line A.4 NOTES:

1. The same Baseline Period must be used for all applicable contaminants identified in A.1 above.

2. For an emission reduction which has physically occurred (past reduction), the Baseline Period consists of any 24 consecutive months within the five (5) years immediately preceding the emission reduction date (Line A.2 above).

3. For a future emission reduction, the Baseline Period consists of any 24 consecutive months within the five (5) years immediately preceding the date of receipt by the Department of the permit application for the project which proposes to use the emission reduction credits as emission offsets or for netting purposes.

Determination of Baseline Actual Emissions for the reduction(s)

B.1 Enter the Baseline Actual Emissions (231-4.1(b)(4)) in tons per year (tpy) for each applicable nonattainment contaminant (attach data summaries and calculations):

NO_x 170.92 VOC 0.72 PM-10 ______

B.2 State Register or Federal Register publication notice date proposing any RACT, MACT or other control requirement (OCR) that may be applicable to the emission source for which ERCs are requested:

Contaminant	RACT Date	MACT Date	OCR Date *
NO_x	11 / 1 / 2009	/ /	/ /
VOC	/ /	/ /	/ /
PM-10	/ /	/ /	/ /

*- Identify OCR that applies: 6 NYCRR 227-2

B.3 Emission Reduction Date (from Line A.2 on page 2) May / 1 / 2023

B.4 What are the Baseline Actual Emissions reflecting RACT, if applicable (tpy)? (see notes)

NO_x 126.04 VOC 0.72 PM-10 ______

B.5 What are the Baseline Actual Emissions reflecting MACT, if applicable (tpy)? (see notes)

NO_x ______ VOC ______ PM-10 ______

B.6 What are the Baseline Actual Emissions reflecting OCR, if applicable (tpy)? (see notes)

NO_x 126.04 VOC 0.72 PM-10 ______

Lines B.4, B.5 and B.6 NOTES.

1. Attach data summaries and calculations.
2. For a past emission reduction that physically occurred after a State or Federal Register publication date proposing an applicable RACT, MACT or OCR, the Baseline Actual Emissions must be adjusted to reflect the applicable RACT, MACT or OCR.
3. For a future emission reduction, if the date that the emission reduction credits are approved is after a State or Federal Register publication date proposing an applicable RACT, MACT or OCR, then the Baseline Actual Emissions must be adjusted to reflect the applicable RACT, MACT or OCR.

DEC ID#: 2-6301-00191 Emission Source ID#: GT21A, GT21B, GT22A, GT22B, GT23A, GT23B, GT24A, GT24B, GT31A, GT31B, GT32A, GT32B, GT33A, GT33B, GT34A, GT34B, GT41A, GT41B, GT42A, GT42B, GT43A, GT43B, GT44A, GT44B

Determination of Emission Reduction Credit(s)

B.7 Enter the lesser of the Baseline Actual Emissions from Lines B.1, B.4, B.5 or B.6 (tpy):

NO_x 126.04 VOC 0.72 PM-10 _______

B.8 Enter the future Potential-To-Emit (PTE) as defined in 6 NYCRR Part 200 (tpy):

NO_x 0 VOC 0 PM-10 _______

B.9 Subtract Line B.8 from Line B.7. These are the emission reduction credits (tpy). If Line B.8 is greater than Line B.7, enter zero.

NO_x 126.04 VOC 0.72 PM-10 _______

Attachment A-7

Use of ERC Form Signed

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Division of Air Resources, Bureau of Stationary Sources
625 Broadway, Albany, New York 12233-3254
P: (518) 402-8403 | F: (518) 402-9035
www.dec.ny.gov

USE OF EMISSION REDUCTION CREDITS (ERC) FORM *

☒ FACILITY ☐ BROKER / ☒ USING ☐ PURCHASING ERC (check appropriate boxes)
(Facility) / (Broker) Name: Astoria Gas Turbine Power DEC ID#: 2-6301-00191
Address: 31-01 20th Avenue Astoria, NY 11105
Proposed Project Description: Turbine replacement with GE H-Class simple cycle turbine
Contact Name: Elizabeth Vaccaro Phone #: 718-429-0022
Name of Authorized Representative: Andrew Scano Title: Plant Manager
Signature of Authorized Representative: Andrew Scano Date: 4/ 23 / 2020

☒ FACILITY ☐ BROKER / ☒ CREATING ☐ TRANSFERRING ERC (check appropriate boxes)
(Facility) / (Broker) Name: Astoria Gas Turbine Power DEC ID#: 2-6301-00191
Address: 31-01 20th Avenue Astoria, NY 11105
ERC Emission Source ID#(s) / ERC tpy: A-00005 / 126.04 tpy NOx; A-00005 / 0.72 tpy VOC
_____ / _____; _____ / _____; **or**
ERC Emission Unit ID#(s) / ERC tpy: _____ / _____; _____ / _____;
_____ / _____; _____ / _____;
Reduction Mechanism: Shutdown of 22 simple cycle turbines, curtailment of 2 turbines
Name of Authorized Representative: Andrew Scano Title: Plant Manager
Signature of Authorized Representative: Andrew Scano Date: 4 / 23 /2020

AMOUNT OF EMISSION REDUCTION CREDIT BEING ☒ USED / ☐ TRANSFERRED

(complete all that apply)

NOx		**PM-10**	
offsets _____ tpy	netting 72.55 tpy	offsets _____ tpy	netting _____ tpy
VOC		**PM-2.5**	
offsets _____ tpy	netting 0.50 tpy	offsets _____ tpy	netting _____ tpy
SO_2			
offsets _____ tpy	netting _____ tpy		

***NOTE:** Any previous Use of ERC Forms associated with the ERCs being used or transferred with this transaction must be attached.

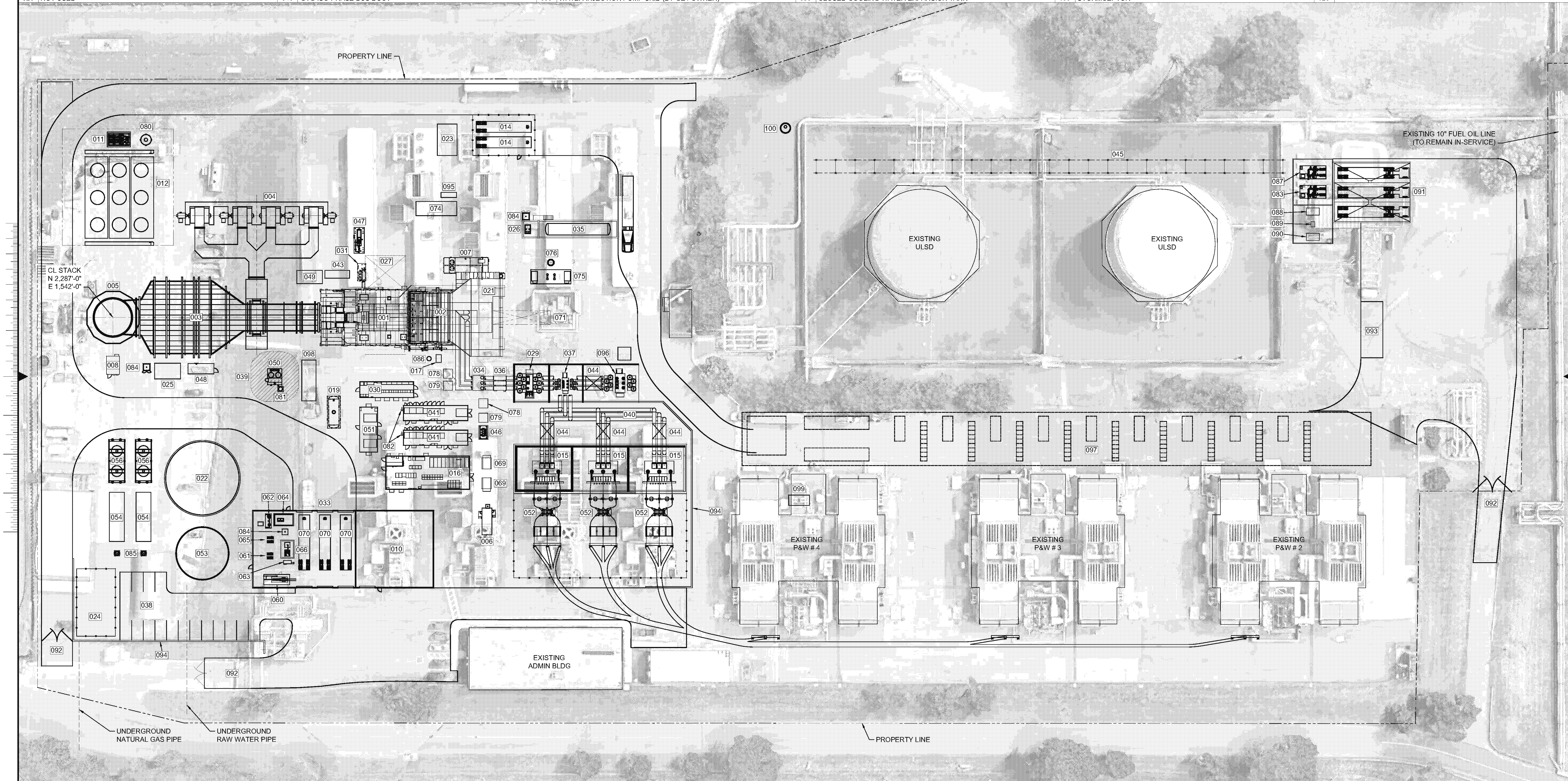
3/16/2012 Version 2.3

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

Appendix B

Project Site Plan

REF	DESCRIPTION	REF	DESCRIPTION	REF	DESCRIPTION	REF	DESCRIPTION	REF	DESCRIPTION	REF	DESCRIPTION
001	GAS TURBINE (GT) (BY GE / OWNER)	021	GT INLET FILTER HOUSE (BY GE / OWNER)	041	LCI COMPARTMENT (BY GE / OWNER)	061	DEMINERALIZED WATER PUMPS SKID	081	FUEL GAS DRAINS TANK	101	
002	GAS TURBINE GENERATOR (GTG) (BY GE / OWNER)	022	DEMINERALIZED WATER TANK	042	NOT USED	062	CARTRIDGE FILTER	082	LEC HEAT EXCHANGER	102	
003	SCR / CO2 CATALYST (BY GE / OWNER)	023	CO2 STORAGE AREA (BY OWNER)	043	FALSE START / WASH WATER DRAIN TANK	063	DEMINERALIZED WATER SAMPLE PANEL	083	FUEL OIL UNLOADING PUMPS	103	
004	TEMPERING / PURGE FANS (BY GE / OWNER)	024	FUEL GAS METERING	044	DISCONNECT SWITCH OR CIRCUIT BREAKER	064	DEMINERALIZED WATER SUMP & PUMPS	084	SAFETY SHOWER / EYEWASH STATION	104	
005	STACK (BY GE / OWNER)	025	AMMONIA VAPORIZATION SKID (BY GE / OWNER)	045	FUEL OIL AREA PIPE RACK	065	SERVICE WATER PUMPS SKID	085	FUEL GAS COMPRESSOR SUCTION SCRUBBERS	105	
006	EMERGENCY DIESEL GENERATOR	026	AQUEOUS AMMONIA FORWARDING PUMPS SKID	046	EXCITATION TRANSFORMER (BY GE / OWNER)	066	AMMONIA CHEMICAL FEED	086	INSTRUMENT AIR RECEIVER	106	
007	LUBE OIL MODULE (BY GE / OWNER) & CONTAINMENT	027	GT MAINTENANCE AREA	047	LIQUID FUEL PUMP SKID (BY GE / OWNER)	067	NOT USED	087	FUEL OIL FORWARDING PUMPS	107	
008	CEMS	028	NOT USED	048	WATER MIST (FIRE PROTECTION) SKID (BY GE / OWNER)	068	NOT USED	088	FUEL OIL HEATER TRANSFORMER	108	
009	NOT USED	029	ISOLATION TRANSFORMER (BY GE / OWNER)	049	WATER WASH SKID (BY GE / OWNER)	069	STATION SERVICE TRANSFORMERS	089	FUEL OIL HEATER SWITCHBOARD	109	
010	WAREHOUSE	030	PEECC (BY GE / OWNER)	050	ABSOLUTE FUEL GAS FILTER SEPARATOR SKID (BY GE / OWNER)	070	DEMINERALIZED TRAILERS (BY OWNER)	090	FUEL OIL HEATER	110	
011	CLOSED COOLING WATER PUMP (BY GE / OWNER)	031	LIQUID FUEL FILTRATION SKID (BY GE / OWNER)	051	BATTERY COMPARTMENT (BY GE / OWNER)	071	GENERATOR ROTOR REMOVAL AREA	091	FUEL OIL UNLOADING AREA	111	
012	COOLING FAN MODULE (BY GE / OWNER)	032	NOT USED	052	138 kV BREAKERS	072	NOT USED	092	SECURITY GATE	112	
013	NOT USED	033	WATER TREATMENT ENCLOSURE	053	SERVICE WATER / FIRE WATER TANK	073	NOT USED	093	FIRE PROTECTION EQUIPMENT ENCLOSURE	113	
014	HYDROGEN STORAGE TRAILERS (BY OWNER)	034	VT COMPARTMENT (BY GE / OWNER)	054	GAS COMPRESSOR	074	GT ANTI-ICING HEATER SKID (BY GE / OWNER)	094	RETAINING WALL	114	
015	GSU TRANSFORMERS (BY OWNER)	035	AMMONIA STORAGE TANK CONTAINMENT	055	NOT USED	075	COMPRESSED AIR SKID	095	COOLING WATER HEATER CONTROL PANEL (BY GE)	115	
016	PDC	036	GENERATOR CIRCUIT BREAKER	056	GAS COMPRESSOR FIN-FAN COOLER	076	DRY AIR RECEIVER	096	BLACKSTART TRANSFORMER	116	
017	WET COMPRESSION SKID	037	AUXILIARY TRANSFORMER	057	NOT USED	077	NOT USED	097	FUTURE BATTERY STORAGE AREA	117	
018	NOT USED	038	PARKING	058	NOT USED	078	DC LINK REACTOR	098	FUEL GAS ELECTRIC STARTUP HEATER	118	
019	OIL WATER SEPARATOR	039	CLASS 1 DIV 2 AREA (BY GE / OWNER)	059	NOT USED	079	AC LINE REACTOR	099	ULSK TANK	119	
020	NOT USED	040	GTG ISO-PHASE BUS DUCT	060	WATER INJECTION PUMP SKID (BY GE / OWNER)	080	CLOSED COOLING WATER EXPANSION TANK	100	STORMCEPTOR	120	



PRELIMINARY - NOT FOR CONSTRUCTION

no.	date	by	ckd	description
2	09/16/20	CSH		ISSUED FOR PERMITTING
1	08/27/20	CSH		ISSUED FOR PERMITTING

TRUE NORTH
~44.37°
PLAN NORTH
NORTH

0 30' 60'
SCALE IN FEET

BURNS McDONNELL
9400 WARD PARKWAY
KANSAS CITY, MO 64114
816-333-9400
FIRM LICENSEE NO. 0011996

SKANSKA
75-20 ASTORIA BLVD
SUITE 200
EAST ELMHURST, NY 11370
718-340-0777

designed: C. HAMKER
detailed: K. KOCH

nrg.
ASTORIA GENERATING STATION
QUEENS COUNTY, NEW YORK

ASTORIA REPLACEMENT PROJECT
1 x 7HA.03 DUAL FUEL PEAKER
GENERAL ARRANGEMENT - SITE PLAN

project: 126819
contract:
drawing: SKGA01 —
rev.: 2
sheet 1 of 1 sheets
file 126819SKGA01.dwg

\\BMCD\DFS\CLIENTS\ENR\NRGENERGY_CLIENTINFO\PURSUITS\120003_ASTORIASC\PROPOSAL\3_WORKINGFILES\GENERALARRANGEMENT\126819SKGA01.DWG 9/16/2020 2:34 PM KKOCH

Appendix C

Emissions Calculations

NRG Astoria Turbine Replacement Project
Project Emissions and Netting (Prevention of Significant Deterioration, Nonattainment New Source Review, and MACT Applicability)

Hourly-Per Event Emissions		NOx (lb)	VOC (lb)	CO (lb)	PM (lb)	PM10 (lb)	PM2.5 (lb)	SO2 (lb)	H2SO4 (lb)	CO2e (ton)	Lead (lb)	HAPs (lb)	Formaldehyde (lb)
H-Class Turbine	SS Gas	36.48	10.15	31.08	25.30	25.30	25.30	5.56	3.66	232.55		2.75	1.69
H-Class Turbine	Gas SU/SD	252.5	72.0	240.0	15.67	15.7	15.7	3.20	2.10	135.44		2.07	1.43
H-Class Turbine	SS Oil	77.61	10.80	47.23	71.10	71.10	71.10	6.13	4.04	326.18	0.056	4.51	0.67
H-Class Turbine	Oil SU/SD	347.0	148.0	651.0	43.97	44.0	44.0	3.60	2.37	191.07	0.033	2.91	0.58
Emergency Generator		0.82	0.23	4.28	0.04	0.04	0.04	0.008	0.0012	0.41		0.008	0.0004
Fire Water Pump #1		1.03	0.04	1.29	0.08	0.08	0.08	0.002	0.0003	0.10		0.0045	0.0014
Fire Water Pump #2		1.56	0.05	1.37	0.08	0.08	0.08	0.003	0.0004	0.15		0.0069	0.0021

Annual Hours/events			ton/yr	NOx	VOC	CO	PM	PM10	PM2.5	SO2	H2SO4	CO2e	Lead	Total HAPs	Formaldehyde
1900	hrs/yr	H-Class Turbine	SS Gas	34.65	9.64	29.52	24.04	24.04	24.04	5.29	3.48	441,837		2.61	1.60
180	SU/SD cyc	H-Class Turbine	Gas SU/SD	22.73	6.48	21.60	1.41	1.41	1.41	0.29	0.19	24,380		0.19	0.13
720	hrs/yr	H-Class Turbine	SS Oil	27.94	3.89	17.00	25.60	25.60	25.60	2.21	1.45	234,850	0.020	1.62	0.24
65	SU/SD cyc	H-Class Turbine	Oil SU/SD	11.28	4.81	21.16	1.43	1.43	1.43	0.12	0.08	12,420	0.001	0.09	0.02
		H-Class Turbine	Total	96.60	24.82	89.29	52.47	52.47	52.47	7.90	5.20	713,487	0.02	4.52	1.99
500	hrs/yr	Emergency Generator		0.20	0.06	1.07	0.009	0.009	0.009	0.002	0.0003	204		0.002	0.0001
500	hrs/yr	Fire Water Pump #1		0.26	0.01	0.32	0.019	0.019	0.019	0.0005	0.0001	48		0.0011	0.0003
500	hrs/yr	Fire Water Pump #2		0.39	0.01	0.34	0.020	0.020	0.020	0.0007	0.0001	73		0.0017	0.0005
		ULSD Storage Tanks			0.50									0.044	
		ULSK Storage Tank			0.002									0.0003	
		Fugitive Emissions										2,708			
		Project Emission Potential (PEP)		**97.45**	**25.40**	**91.02**	**52.52**	**52.52**	**52.52**	**7.90**	**5.20**	**716,519.9**	**0.021**	**4.56**	**1.99**
		Significant Project Threshold		2.5	2.5	100	25	15	10	40	7	75,000	0.6	**25**	**10**
		Significant Project ?		**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**No**	**No**	**Yes, PSD**	**No**	**No**	**No**

Determination of Net Emission Increase (NEI) for Significant Project Emissions (ton/yr)	NOx	VOC	CO	PM	PM10	PM2.5	SO2	H2SO4	CO2e	Lead	Total HAPs	Formaldehyde
Project Emission Potential (PEP)	97.45	25.40		52.52	52.52	52.52						
Contemporaneous Creditable Emission Increase (CEI)	0.00	0.00		0.00	0.00	0.00						
Use of ERCs (NOx and VOC only)	72.55	0.50		0.00	0.00	0.00						
Net Emissions Increase (NEI) = PEP + CEI - ERC	**24.90**	**24.90**		**52.50**	**52.50**	**52.50**						
Significant Net Emissions Increase Threshold	25	25	100	25	15	10	40	7	N/A	0.6		
Significant Net Emissions Increase?	**No**	**No**	**N/A**	**Yes, PSD**	**Yes, PSD**	**Yes, PSD**	**N/A**	**N/A**	**N/A**	**N/A**		

Facility Total ton/yr	NOx	VOC	CO	PM	PM10	PM2.5	SO2	H2SO4	CO2e	Lead	Total HAPs	Formaldehyde
Project	97.45	25.40	91.02	52.52	52.52	52.52	7.90	5.20	716,520	0.02	4.6	1.99
P&W Black Start	2.99	0.01	1.18	0.11	0.11	0.11	0.01	0.00	482	0.00004	0.006	0.002
Facility Total PTE	**100.44**	**25.41**	**92.20**	**52.63**	**52.63**	**52.63**	**7.91**	**5.20**	**717,002**	**0.02**	**4.57**	**2.00**

Emission Reduction Credits (NOx & VOC)	**Uncorrected for NOx RACT**		**NOx RACT Corrected**			
	NOx Tons	**NOx Pounds**	**NOx Tons**	**NOx Pounds**	**VOC Tons**	**VOC Pounds**
ERC Creation - 22 Retired P&W Turbines (Baseline)	**156.87**	**313,746**	**116.17**	**232,347**	**0.65**	**1,301**
ERC Creation - 2 Curtailed P&W Turbines (Baseline)	**17.03**	**34,068**	**12.86**	**25,711**	**0.07**	**144**
2 P&W Turbines To Remain (Curtailed Emissions)	**-2.99**	**-5,979**	**-2.99**	**-5,979**	**-0.01**	**-13**
Baseline Actual Emissions / ERCs Created	**170.92**	**341,835**	**126.04**	**252,079**	**0.72**	**1,432**
ERCs Used for Project Netting			**-72.55**	**-145,105**	-0.50	**-1,001**
ERCs Remaining After Project Use			**53.49**	**106,974**	**0.22**	**431**

GE 7HA.03 Steady State Natural Gas		Case 25	Case 26	Case 27	Case 28	Case 29	Case 30	Case 31	Case 32	Case 33	Case 42	Case 43	Case 44	Case 45
Performance and Emissions Data		Nat. Gas	Nat. Gas	Nat. Gas	Nat. Gas	Nat. Gas	Nat. Gas	Nat. Gas	Nat. Gas	Nat. Gas	Nat. Gas	Nat. Gas	Nat. Gas	Nat. Gas
Load		Base	Base	75% Load	50% Load	30% Load	Base	75% Load	50% Load	30% Load	Base	75% Load	50% Load	39.38% Load
Wet compression		0	0	0	0	MECL	0	0	0	MECL	0	0	0	MECL
Evaporative Cooling		Evap On	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off
Ambient pressure	psia	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69
Ambient temperature	°F	59	59	59	59	59	54.6	54.6	54.6	54.6	-5	-5	-5	-5
Ambient relative humidity	%	60	60	60	60	60	55	55	55	55	56	56	56	56
CTG fuel input (HHV)	MMBtu/hr	3,906	3,835	2,957	2,241	1,650	3,875	2,985	2,260	1,662	3,929	3,055	2,327	2,009
Gross Power Output	MW	437.4	428.3	321.2	214.1	128.5	433.7	325.3	216.9	130.1	438.3	328.7	219.1	172.6
Heat Rate (gross, HHV)	Btu/kWh	8,932	8,955	9,207	10,464	12,844	8,934	9,176	10,419	12,776	8,965	9,292	10,620	11,642
Heat Rate (gross, HHV) +6.575% for performance margin and degradation from new/clean	Btu/kWh	9,519	9,544	9,812	11,153	13,689	9,521	9,779	11,104	13,616	9,555	9,903	11,318	12,408
Stack gas temperature	°F	840	840.01	840	840	840	840	840	840	840	840	840	840	840
Stack gas mass flow	kpph	9,855	9,761	7,633	6,278	5,114	9,802	7,656	6,289	5,119	9,314	7,408	6,139	5,561
Stack gas molecular weight	lb/lbmol	28.47	28.49	28.49	28.52	28.55	28.51	28.52	28.54	28.57	28.56	28.57	28.60	28.62
Stack gas N2	mol %	74.90	75.03	75.07	75.25	75.44	75.19	75.22	75.40	75.59	75.59	75.64	75.83	75.94
Stack gas O2	mol %	14.20	14.28	14.38	14.87	15.43	14.29	14.37	14.87	15.44	13.99	14.14	14.68	14.98
Stack gas CO2	mol %	3.01	2.98	2.94	2.71	2.46	3.00	2.96	2.74	2.48	3.21	3.14	2.89	2.76
Stack gas H2O	mol %	6.99	6.80	6.72	6.27	5.77	6.62	6.54	6.09	5.59	6.31	6.17	5.69	5.42
Stack gas Ar	mol %	0.90	0.90	0.89	0.91	0.91	0.90	0.91	0.90	0.90	0.90	0.91	0.91	0.91
Stack gas flow rate	ACFM	5,476,824	5,420,763	4,238,628	3,482,265	2,833,630	5,439,333	4,248,128	3,485,969	2,834,470	5,158,889	4,102,233	3,396,026	3,074,107
Stack diameter	ft	28.5	28.5	28.5	28.5	28.5	28.5	28.5	28.5	28.5	28.5	28.5	28.5	28.5
Stack exit velocity	ft/s	143.1	141.6	110.7	91.0	74.0	142.1	111.0	91.1	74.1	134.8	107.2	88.7	80.3
Stack exit velocity	m/s	43.61	43.17	33.75	27.73	22.56	43.31	33.83	27.76	22.57	41.08	32.67	27.04	24.48

Emissions

NOx	ppmvdc	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	lb/MMBtu	0.0092	0.0092	0.0092	0.0092	0.0092	0.0092	0.0092	0.0092	0.0092	0.0092	0.0092	0.0092	0.0092
	lb/hr	35.95	35.30	27.22	20.62	15.19	35.67	27.47	20.80	15.30	36.17	28.11	21.42	18.49
	g/s	4.5301	4.4476	3.4295	2.5986	1.9138	4.4938	3.4615	2.6203	1.9278	4.5567	3.5423	2.6989	2.3300

NOx lb/MMBtu = 20.9 / (20.9-15% O2) * 8710 dscf/MMBtu * (2.5 ppmvd / 1,000,000) * 46.01 lb NOx/lb-mol / 385.6 scf/lb-mol
NOx lb/hr = lb/MMBtu * MMBtu/hr
NOx g/s = lb/hr * 453.59 g/lb / 3600 s/hr

GE 7HA.03 Steady State Natural Gas		Case 25	Case 26	Case 27	Case 28	Case 29	Case 30	Case 31	Case 32	Case 33	Case 42	Case 43	Case 44	Case 45
Performance and Emissions Data		Nat. Gas	Nat. Gas	Nat. Gas	Nat. Gas	Nat. Gas	Nat. Gas	Nat. Gas	Nat. Gas	Nat. Gas	Nat. Gas	Nat. Gas	Nat. Gas	Nat. Gas
Load		Base	Base	75% Load	50% Load	30% Load	Base	75% Load	50% Load	30% Load	Base	75% Load	50% Load	39.38% Load
Wet compression		0	0	0	0	MECL	0	0	0	MECL	0	0	0	MECL
Evaporative Cooling		Evap On	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off
Ambient pressure	psia	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69
Ambient temperature	°F	59	59	59	59	59	54.6	54.6	54.6	54.6	-5	-5	-5	-5
Ambient relative humidity	%	60	60	60	60	60	55	55	55	55	56	56	56	56
$PM/PM_{10}/PM_{2.5}$	lb/hr	24.20	24.10	17.70	16.70	15.90	24.10	17.70	16.70	15.90	22.40	17.50	16.50	16.10
	lb/MMBtu	0.00619	0.00628	0.00599	0.00745	0.00963	0.00622	0.00593	0.00739	0.00956	0.00570	0.00573	0.00709	0.00801
	g/s	3.0491	3.0365	2.2302	2.1042	2.0034	3.0365	2.2302	2.1042	2.0034	2.8223	2.2050	2.0790	2.0286

PM/PM10/PM2.5 lb/hr = as provided by turbine manufacturer
PM/PM10/PM2.5 lb/MMBtu = lb/hr / MMBtu/hr
PM/PM10/PM2.5 g/s = lb/hr * 453.59 g/lb / 3600 s/hr

CO	ppmvdc	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
	lb/MMBtu	0.00784	0.00784	0.00784	0.00784	0.00784	0.00784	0.00784	0.00784	0.00784	0.00784	0.00784	0.00784	0.00784
	lb/hr	30.63	30.07	23.19	17.57	12.94	30.39	23.41	17.72	13.04	30.81	23.95	18.25	15.76
	g/s	3.8596	3.7893	2.9219	2.2140	1.6305	3.8286	2.9492	2.2325	1.6425	3.8823	3.0180	2.2994	1.9851

CO lb/MMBtu = 20.9 / (20.9-15% O2) * 8710 dscf/MMBtu * (3.5 ppmvd / 1,000,000) * 28 lb CO/lb-mol / 385.6 scf/lb-mol
CO lb/hr = lb/MMBtu * MMBtu/hr
CO g/s = lb/hr * 453.59 g/lb / 3600 s/hr

VOC	ppmvdc	2	2	2	2	2	2	2	2	2	2	2	2	2
	lb/MMBtu	0.00256	0.00256	0.00256	0.00256	0.00256	0.00256	0.00256	0.00256	0.00256	0.00256	0.00256	0.00256	0.00256
	lb/hr	10.00	9.82	7.57	5.74	4.23	9.92	7.64	5.79	4.26	10.06	7.82	5.96	5.14

VOC lb/MMBtu = 20.9 / (20.9-15% O2) * 8710 dscf/MMBtu * (2 ppmvd / 1,000,000) * 16 lb VOC/lb-mol / 385.6 scf/lb-mol
VOC lb/hr = lb/MMBtu * MMBtu/hr

SO2	lb/MMBtu	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014
	lb/hr	5.48	5.38	4.15	3.15	2.32	5.44	4.19	3.17	2.33	5.52	4.29	3.27	2.82
	g/s	0.6910	0.6784	0.5231	0.3964	0.2919	0.6854	0.5280	0.3997	0.2940	0.6950	0.5403	0.4117	0.3554

SO2 lb/MMBtu = (0.5 gr S / 100 scf) * (379 scf/lb-mol / 16.53 lb/lb-mol) * (2 lb-mol SO2 / lb-mol S) * (lb/7,000 gr) * (1,000,000 Btu/MMBtu / 23,325 Btu/lb)
SO2 lb/hr = lb/MMBtu * MMBtu/hr
SO2 g/s = lb/hr * 453.59 g/lb / 3600 s/hr

H2SO4	lb/MMBtu	0.00092	0.00092	0.00092	0.00092	0.00092	0.00092	0.00092	0.00092	0.00092	0.00092	0.00092	0.00092	0.00092
	lb/hr	3.61	3.55	2.73	2.07	1.53	3.58	2.76	2.09	1.54	3.63	2.82	2.15	1.86

H2SO4 lb/MMBtu = (0.0014 lb SO2/MMBtu * 0.05 * (98 lb H2SO4/64 lb SO2)) + (0.0014 lb SO2/MMBtu * 0.95 * 0.4 * (98 lb H2SO4/64 lb SO2))
Assumes 5% created from CTG and 40% created from catalyst reactions, based on 95% SO2 remaining after CTG
H2SO4 lb/hr = lb/MMBtu * MMBtu/hr

GE 7HA.03 Steady State Natural Gas		Case 25	Case 26	Case 27	Case 28	Case 29	Case 30	Case 31	Case 32	Case 33	Case 42	Case 43	Case 44	Case 45
Performance and Emissions Data		Nat. Gas	Nat. Gas	Nat. Gas	Nat. Gas	Nat. Gas	Nat. Gas	Nat. Gas	Nat. Gas	Nat. Gas	Nat. Gas	Nat. Gas	Nat. Gas	Nat. Gas
Load		Base	Base	75% Load	50% Load	30% Load	Base	75% Load	50% Load	30% Load	Base	75% Load	50% Load	39.38% Load
Wet compression		0	0	0	0	MECL	0	0	0	MECL	0	0	0	MECL
Evaporative Cooling		Evap On	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off
Ambient pressure	psia	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69
Ambient temperature	°F	59	59	59	59	59	54.6	54.6	54.6	54.6	-5	-5	-5	-5
Ambient relative humidity	%	60	60	60	60	60	55	55	55	55	56	56	56	56
CO_2	ton/hr	229.0	224.6	173.2	131.2	96.7	226.9	174.7	132.7	97.5	230.2	178.9	136.3	117.7
	lb/hr	457,911	449,148	346,418	262,404	193,462	453,829	349,474	265,328	195,001	460,418	357,737	272,618	235,394
	lb/MMBtu	117.2	117.1	117.1	117.1	117.2	117.1	117.1	117.4	117.3	117.2	117.1	117.1	117.2
	lb/MW-hr	1,047.0	1,048.7	1,078.5	1,225.4	1,505.7	1,046.3	1,074.3	1,223.4	1,498.6	1,050.5	1,088.3	1,244.0	1,364.0

CO_2 ton/hr = $5.7*10^{-7}$ (tons/scf)/%CO_2 * %CO_2 * (acfm * 60 * (460 + 68 ºF)/ (460 + 840 ºF))

Based on Part 75, Appendix F, equation F-11 for wet basis - same value if using equation F-2 for dry basis

CO_2 lb/hr = ton/hr * 2,000 lb/ton

CO_2 lb/MMBtu = lb/hr / MMBtu/hr

CO_2 lb/MW-hr = lb/hr / MW-hr (gross basis)

GHG (as CO_2e)	lb/MMBtu	117.34	117.23	117.26	117.22	117.35	117.24	117.20	117.54	117.42	117.29	117.24	117.26	117.28
	lb/hr	458,383	449,611	346,775	262,674	193,661	454,297	349,835	265,601	195,202	460,893	358,106	272,899	235,637
	lb/MW-hr	1,048	1,050	1,080	1,227	1,507	1,047	1,075	1,225	1,500	1,052	1,089	1,245	1,365

CO_2e lb/MMBtu = (CO_2 lb/hr / MMBtu/hr) + (25 CO_2e/CH_4 * 0.001 kg CH_4/MMBtu * 2.20462 lb/kg) + (298 CO_2e/N_2O * 0.001 kg N_2O/MMBtu * 2.20462 lb/kg)

CO_2e lb/hr = CO_2 lb/hr + (MMBtu/hr *25 CO_2e/CH_4 * 0.001 kg CH_4/MMBtu * 2.20462 lb/kg) + (MMBtu/hr *298 CO_2e/N_2O * 0.0001 kg N_2O/MMBtu * 2.20462 lb/kg)

CO_2e lb/MW-hr = CO_2e lb/hr / MW-hr (gross basis)

GHG (as CO_2e) +6.575% for performance margin and degradation from new/clean	lb/MW-hr	1,117	1,119	1,151	1,307	1,606	1,116	1,146	1,305	1,599	1,121	1,161	1,327	1,455

CO_2e lb/MW-hr (accounting for degredation from new and clean) = CO_2e lb/MW-hr * 1.06575

NH_3 slip	ppmvdc	5	5	5	5	5	5	5	5	5	5	5	5	5
	lb/MMBtu	0.00680	0.00680	0.00680	0.00680	0.00680	0.00680	0.00680	0.00680	0.00680	0.00680	0.00680	0.00680	0.00680
	lb/hr	26.57	26.09	20.11	15.24	11.22	26.36	20.30	15.37	11.31	26.73	20.78	15.83	13.67

NH_3 lb/MMBtu = 20.9 / (20.9-15% O_2) * 8710 dscf/MMBtu * (5 ppmvd / 1,000,000) * 17 lb VOC/lb-mol / 385.6 scf/lb-mol

NH_3 lb/hr = lb/MMBtu * MMBtu/hr

GE 7HA.03 Steady State Natural Gas		Case 25	Case 26	Case 27	Case 28	Case 29	Case 30	Case 31	Case 32	Case 33	Case 42	Case 43	Case 44	Case 45
Performance and Emissions Data		Nat. Gas	Nat. Gas	Nat. Gas	Nat. Gas	Nat. Gas	Nat. Gas	Nat. Gas	Nat. Gas	Nat. Gas	Nat. Gas	Nat. Gas	Nat. Gas	Nat. Gas
Load		Base	Base	75% Load	50% Load	30% Load	Base	75% Load	50% Load	30% Load	Base	75% Load	50% Load	39.38% Load
Wet compression		0	0	0	0	MECL	0	0	0	MECL	0	0	0	MECL
Evaporative Cooling		Evap On	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off
Ambient pressure	psia	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69
Ambient temperature	°F	59	59	59	59	59	54.6	54.6	54.6	54.6	-5	-5	-5	-5
Ambient relative humidity	%	60	60	60	60	60	55	55	55	55	56	56	56	56
Total HAPs	lb/MMBtu	1.16E-03	1.16E-03	1.16E-03	1.16E-03	1.16E-03	1.16E-03	1.16E-03	1.16E-03	1.16E-03	1.16E-03	1.16E-03	1.16E-03	1.16E-03
	lb/hr	2.71	2.66	2.05	1.55	1.14	2.69	2.07	1.57	1.15	2.73	2.12	1.61	1.39

Total HAPs = sum of individual HAP lb/MMBtu or lb/hr

1,3-Butadine (lb/hr includes 40% control)	lb/MMBtu	4.30E-07	4.30E-07	4.30E-07	4.30E-07	4.30E-07	4.30E-07	4.30E-07	4.30E-07	4.30E-07	4.30E-07	4.30E-07	4.30E-07	4.30E-07
	lb/hr	1.01E-03	9.90E-04	7.63E-04	5.78E-04	4.26E-04	1.00E-03	7.70E-04	5.83E-04	4.29E-04	1.01E-03	7.88E-04	6.00E-04	5.18E-04
Acetaldehyde (lb/hr includes 40% control)	lb/MMBtu	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05
	lb/hr	9.38E-02	9.20E-02	7.10E-02	5.38E-02	3.96E-02	9.30E-02	7.16E-02	5.42E-02	3.99E-02	9.43E-02	7.33E-02	5.59E-02	4.82E-02
Acrolein (lb/hr includes 40% control)	lb/MMBtu	6.40E-06	6.40E-06	6.40E-06	6.40E-06	6.40E-06	6.40E-06	6.40E-06	6.40E-06	6.40E-06	6.40E-06	6.40E-06	6.40E-06	6.40E-06
	lb/hr	1.50E-02	1.47E-02	1.14E-02	8.60E-03	6.34E-03	1.49E-02	1.15E-02	8.68E-03	6.38E-03	1.51E-02	1.17E-02	8.94E-03	7.72E-03
Benzene (lb/hr includes 40% control)	lb/MMBtu	1.20E-05	1.20E-05	1.20E-05	1.20E-05	1.20E-05	1.20E-05	1.20E-05	1.20E-05	1.20E-05	1.20E-05	1.20E-05	1.20E-05	1.20E-05
	lb/hr	2.81E-02	2.76E-02	2.13E-02	1.61E-02	1.19E-02	2.79E-02	2.15E-02	1.63E-02	1.20E-02	2.83E-02	2.20E-02	1.68E-02	1.45E-02
Ethylbenzene (lb/hr includes 40% control)	lb/MMBtu	3.20E-05	3.20E-05	3.20E-05	3.20E-05	3.20E-05	3.20E-05	3.20E-05	3.20E-05	3.20E-05	3.20E-05	3.20E-05	3.20E-05	3.20E-05
	lb/hr	7.50E-02	7.36E-02	5.68E-02	4.30E-02	3.17E-02	7.44E-02	5.73E-02	4.34E-02	3.19E-02	7.54E-02	5.86E-02	4.47E-02	3.86E-02
Formaldehyde (lb/hr includes 40% control)	lb/MMBtu	7.10E-04	7.10E-04	7.10E-04	7.10E-04	7.10E-04	7.10E-04	7.10E-04	7.10E-04	7.10E-04	7.10E-04	7.10E-04	7.10E-04	7.10E-04
	lb/hr	1.66E+00	1.63E+00	1.26E+00	9.55E-01	7.03E-01	1.65E+00	1.27E+00	9.63E-01	7.08E-01	1.67E+00	1.30E+00	9.91E-01	8.56E-01
PAH (lb/hr includes 40% control)	lb/MMBtu	2.20E-06	2.20E-06	2.20E-06	2.20E-06	2.20E-06	2.20E-06	2.20E-06	2.20E-06	2.20E-06	2.20E-06	2.20E-06	2.20E-06	2.20E-06
	lb/hr	5.16E-03	5.06E-03	3.90E-03	2.96E-03	2.18E-03	5.12E-03	3.94E-03	2.98E-03	2.19E-03	5.19E-03	4.03E-03	3.07E-03	2.65E-03
Propylene Oxide (lb/hr includes 40% control)	lb/MMBtu	2.90E-05	2.90E-05	2.90E-05	2.90E-05	2.90E-05	2.90E-05	2.90E-05	2.90E-05	2.90E-05	2.90E-05	2.90E-05	2.90E-05	2.90E-05
	lb/hr	6.80E-02	6.67E-02	5.15E-02	3.90E-02	2.87E-02	6.74E-02	5.19E-02	3.93E-02	2.89E-02	6.84E-02	5.31E-02	4.05E-02	3.50E-02
Toluene (lb/hr includes 40% control)	lb/MMBtu	1.30E-04	1.30E-04	1.30E-04	1.30E-04	1.30E-04	1.30E-04	1.30E-04	1.30E-04	1.30E-04	1.30E-04	1.30E-04	1.30E-04	1.30E-04
	lb/hr	3.05E-01	2.99E-01	2.31E-01	1.75E-01	1.29E-01	3.02E-01	2.33E-01	1.76E-01	1.30E-01	3.06E-01	2.38E-01	1.82E-01	1.57E-01
Xylenes (lb/hr includes 40% control)	lb/MMBtu	6.40E-05	6.40E-05	6.40E-05	6.40E-05	6.40E-05	6.40E-05	6.40E-05	6.40E-05	6.40E-05	6.40E-05	6.40E-05	6.40E-05	6.40E-05
	lb/hr	1.50E-01	1.47E-01	1.14E-01	8.60E-02	6.34E-02	1.49E-01	1.15E-01	8.68E-02	6.38E-02	1.51E-01	1.17E-01	8.94E-02	7.72E-02

Individual HAPs lb/MMBtu = from AP-42 Section 3.1 (4/00), Table 3.1-3

Individual HAP lb/hr = lb/MMBtu * MMBtu/hr * (1 - 0.4)

40% control for organic HAPs from oxidation catalyst

GE 7HA.03 Steady State ULSD		Case 67	Case 68	Case 69	Case 70	Case 71	Case 72	Case 73	Case 80	Case 81	Case 82
Performance and Emissions Data		ULSD	ULSD	ULSD	ULSD	ULSD	ULSD	ULSD	ULSD	ULSD	ULSD
Load		Base	Base	75% Load	50% Load	Base	75% Load	50% Load	Base	75% Load	63% Load
Wet compression		0	0	0	MECL	0	0	MECL	0	0	MECL
Evaporative Cooling		Evap On	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off
Ambient pressure	psia	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69
Ambient temperature	°F	59	59	59	59	54.6	54.6	54.6	-5	-5	-5
Ambient relative humidity	%	60	60	60	60	55	55	60	56	56	56
CTG fuel input (HHV)	MMBtu/hr	3,962	3,909	3,036	2,367	3,955	3,072	2,395	3,996	3,172	2,833
Gross Power Output	MW	430.3	422.9	317.2	211.5	428.8	321.6	214.4	431.8	323.8	272.0
Heat Rate (gross, HHV)	Btu/kWh	9,207	9,243	9,574	11,193	9,223	9,554	11,170	9,256	9,795	10,417
Heat Rate (gross, HHV) +6.575% for performance margin and degradation from new/clean	Btu/kWh	9,813	9,850	10,203	11,929	9,830	10,182	11,904	9,864	10,439	11,102
Fuel Flow	lb/hr	202,660	199,939	155,319	121,063	202,280	157,149	122,479	204,412	162,238	144,932
Stack gas temperature	°F	840	840	840	840	840	840	840	840	840	840
Stack gas mass flow	kpph	9,447	9,369	7,544	6,640	9,422	7,589	6,676	9,047	7,561	7,076
Stack gas molecular weight	lb/lbmol	28.44	28.45	28.50	28.59	28.47	28.52	28.61	28.54	28.61	28.64
Stack gas N2	mol %	72.55	72.62	73.02	73.89	72.73	73.15	73.98	73.17	73.70	74.04
Stack gas O2	mol %	13.10	13.15	13.47	14.38	13.14	13.47	14.37	12.90	13.37	13.74
Stack gas CO2	mol %	4.42	4.39	4.25	3.78	4.42	4.27	3.81	4.67	4.44	4.25
Stack gas H2O	mol %	9.07	8.97	8.39	7.05	8.84	8.23	6.96	8.39	7.60	7.08
Stack gas Ar	mol %	0.87	0.87	0.88	0.89	0.88	0.88	0.88	0.87	0.89	0.88
Stack gas flow rate	ACFM	5,255,587	5,210,766	4,188,597	3,673,845	5,236,674	4,210,376	3,692,142	5,014,837	4,181,957	3,909,129
Stack diameter	ft	28.5	28.5	28.5	28.5	28.5	28.5	28.5	28.5	28.5	28.5
Stack exit velocity	ft/s	137.3	136.1	109.4	96.0	136.8	110.0	96.5	131.0	109.3	102.1
Stack exit velocity	m/s	41.85	41.49	33.35	29.26	41.70	33.53	29.40	39.93	33.30	31.13

Emissions

NOx	ppmvdc	5	5	5	5	5	5	5	5	5	5
	lb/MMBtu	0.01942	0.01942	0.01942	0.01942	0.01942	0.01942	0.01942	0.01942	0.01942	0.01942
	lb/hr	76.95	75.92	58.97	45.97	76.81	59.67	46.51	77.61	61.60	55.03
	g/s	9.6954	9.5652	7.4307	5.7919	9.6772	7.5182	5.8596	9.7792	7.7617	6.9338

NOx lb/MMBtu = 20.9 / (20.9-15% O2) * 9190 dscf/MMBtu * (5 ppmvd / 1,000,000) * 46.01 lb NOx/lb-mol / 385.6 scf/lb-mol
NOx lb/hr = lb/MMBtu * MMBtu/hr
NOx g/s = lb/hr * 453.59 g/lb / 3600 s/hr

GE 7HA.03 Steady State ULSD		Case 67	Case 68	Case 69	Case 70	Case 71	Case 72	Case 73	Case 80	Case 81	Case 82
Performance and Emissions Data		ULSD	ULSD	ULSD	ULSD	ULSD	ULSD	ULSD	ULSD	ULSD	ULSD
Load		Base	Base	75% Load	50% Load	Base	75% Load	50% Load	Base	75% Load	63% Load
Wet compression		0	0	0	MECL	0	0	MECL	0	0	MECL
Evaporative Cooling		Evap On	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off
Ambient pressure	psia	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69
Ambient temperature	°F	59	59	59	59	54.6	54.6	54.6	-5	-5	-5
Ambient relative humidity	%	60	60	60	60	55	55	60	56	56	56
$PM/PM_{10}/PM_{2.5}$	lb/hr	70.70	70.60	67.90	68.70	70.60	68.10	68.70	69.90	68.60	68.40
	lb/MMBtu	0.01784	0.01806	0.02236	0.02903	0.01785	0.02217	0.02869	0.01749	0.02163	0.02414
	g/s	8.9080	8.8954	8.5552	8.6560	8.8954	8.5804	8.6560	8.8072	8.6434	8.6182

PM/PM10/PM2.5 lb/hr = as provided by turbine manufacturer
PM/PM10/PM2.5 lb/MMBtu = lb/hr / MMBtu/hr
PM/PM10/PM2.5 g/s = lb/hr * 453.59 g/lb / 3600 s/hr

CO	ppmvdc	5	5	5	5	5	5	5	5	5	5
	lb/MMBtu	0.01182	0.01182	0.01182	0.01182	0.01182	0.01182	0.01182	0.01182	0.01182	0.01182
	lb/hr	46.83	46.20	35.89	27.97	46.74	36.31	28.30	47.23	37.49	33.49
	g/s	5.9002	5.8210	4.5220	3.5247	5.8892	4.5753	3.5660	5.9513	4.7235	4.2196

CO lb/MMBtu = 20.9 / (20.9-15% O2) * 9190 dscf/MMBtu * (5 ppmvd / 1,000,000) * 28 lb CO/lb-mol / 385.6 scf/lb-mol
CO lb/hr = lb/MMBtu * MMBtu/hr
CO g/s = lb/hr * 453.59 g/lb / 3600 s/hr

VOC	ppmvdc	2	2	2	2	2	2	2	2	2	2
	lb/MMBtu	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270	0.00270
	lb/hr	10.70	10.56	8.20	6.39	10.68	8.30	6.47	10.80	8.57	7.65

VOC lb/MMBtu = 20.9 / (20.9-15% O2) * 9190 dscf/MMBtu * (2 ppmvd / 1,000,000) * 16 lb VOC/lb-mol / 385.6 scf/lb-mol
VOC lb/hr = lb/MMBtu * MMBtu/hr

SO2	lb/MMBtu	0.00153	0.00153	0.00153	0.00153	0.00153	0.00153	0.00153	0.00153	0.00153	0.00153
	lb/hr	6.08	6.00	4.66	3.63	6.07	4.71	3.67	6.13	4.87	4.35
	g/s	0.7660	0.7558	0.5871	0.4576	0.7646	0.5940	0.4630	0.7727	0.6132	0.5478

SO2 lb/MMBtu = (15 lb S / 1,000,000 lb fuel) * (2 lbs SO2 lb S) * lbs fuel/hr / MMBtu/hr
SO2 lb/hr = lb/MMBtu * MMBtu/hr
SO2 g/s = lb/hr * 453.59 g/lb / 3600 s/hr

H2SO4	lb/MMBtu	0.00101	0.00101	0.00101	0.00101	0.00101	0.00101	0.00101	0.00101	0.00101	0.00101
	lb/hr	4.00	3.95	3.07	2.39	4.00	3.10	2.42	4.04	3.20	2.86

H2SO4 lb/MMBtu = (0.00153 lb SO2/MMBtu * 0.05 * (98 lb H2SO4/64 lb SO2)) + (0.00153 lb SO2/MMBtu * 0.95 * 0.4 * (98 lb H2SO4/64 lb SO2))
Assumes 5% created from CTG and 40% created from catalyst reactions, based on 95% SO2 remaining after CTG
H2SO4 lb/hr = lb/MMBtu * MMBtu/hr

GE 7HA.03 Steady State ULSD		Case 67	Case 68	Case 69	Case 70	Case 71	Case 72	Case 73	Case 80	Case 81	Case 82
Performance and Emissions Data		ULSD	ULSD	ULSD	ULSD	ULSD	ULSD	ULSD	ULSD	ULSD	ULSD
Load		Base	Base	75% Load	50% Load	Base	75% Load	50% Load	Base	75% Load	63% Load
Wet compression		0	0	0	MECL	0	0	MECL	0	0	MECL
Evaporative Cooling		Evap On	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off
Ambient pressure	psia	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69
Ambient temperature	°F	59	59	59	59	54.6	54.6	54.6	-5	-5	-5
Ambient relative humidity	%	60	60	60	60	55	55	60	56	56	56
CO2	ton/hr	322.3	318.0	247.1	192.9	321.7	250.0	195.3	325.1	258.1	230.8
	lb/hr	644,645	635,956	494,239	385,862	643,478	499,968	390,514	650,126	516,278	461,562
	lb/MMBtu	162.7	162.7	162.8	163.0	162.7	162.7	163.1	162.7	162.8	162.9

CO2 ton/hr = 5.7*10^{-7} (tons/scf)/%CO2 * %CO2 * (acfm * 60 * (460 + 68 ºF)/ (460 + 840 ºF))

Based on Part 75, Appendix F, equation F-11 for wet basis - same value if using equation F-2 for dry basis

CO2 lb/hr = ton/hr * 2,000 lb/ton

CO2 lb/MMBtu = lb/hr / MMBtu/hr

CO2 lb/MW-hr = lb/hr / MW-hr (gross basis)

		Case 67	Case 68	Case 69	Case 70	Case 71	Case 72	Case 73	Case 80	Case 81	Case 82
GHG (as CO2e)	lb/MMBtu	163.3	163.3	163.3	163.6	163.3	163.3	163.6	163.2	163.3	163.5
	lb/hr	646,862	638,143	495,938	387,187	645,691	501,687	391,853	652,362	518,053	463,148
	lb/MW-hr	1,503	1,509	1,564	1,831	1,506	1,560	1,828	1,511	1,600	1,703

CO2e lb/MMBtu = (CO2 lb/hr / MMBtu/hr) + (25 CO2e/CH4 * 0.001 kg CH4/MMBtu * 2.20462 lb/kg) + (298 CO2e/N2O * 0.001 kg N2O/MMBtu * 2.20462 lb/kg)

CO2e lb/hr = CO2 lb/hr + (MMBtu/hr *25 CO2e/CH4 * 0.003 kg CH4/MMBtu * 2.20462 lb/kg) + (MMBtu/hr *298 CO2e/N2O * 0.0006 kg N2O/MMBtu * 2.20462 lb/kg)

CO2e lb/MW-hr = CO2e lb/hr / MW-hr (gross basis)

		Case 67	Case 68	Case 69	Case 70	Case 71	Case 72	Case 73	Case 80	Case 81	Case 82
GHG (as CO2e) +6.575% for performance margin and degradation from new/clean	lb/MW-hr	1,602	1,608	1,666	1,951	1,605	1,663	1,948	1,610	1,705	1,815

CO2e lb/MW-hr (accounting for degredation from new and clean) = CO2e lb/MW-hr * 1.06575

		Case 67	Case 68	Case 69	Case 70	Case 71	Case 72	Case 73	Case 80	Case 81	Case 82
NH3 slip	ppmvdc	5	5	5	5	5	5	5	5	5	5
	lb/MMBtu	0.00718	0.00718	0.00718	0.00718	0.00718	0.00718	0.00718	0.00718	0.00718	0.00718
	lb/hr	28.44	28.05	21.79	16.99	28.38	22.05	17.19	28.68	22.76	20.34

NH3 lb/MMBtu = 20.9 / (20.9-15% O2) * 9190 dscf/MMBtu * (5 ppmvd / 1,000,000) * 17 lb VOC/lb-mol / 385.6 scf/lb-mol

NH3 lb/hr = lb/MMBtu * MMBtu/hr

		Case 67	Case 68	Case 69	Case 70	Case 71	Case 72	Case 73	Case 80	Case 81	Case 82
Total HAPs	lb/MMBtu	1.30E-03	1.30E-03	1.30E-03	1.30E-03	1.30E-03	1.30E-03	1.30E-03	1.30E-03	1.30E-03	1.30E-03
	lb/hr	4.47	4.41	3.43	2.67	4.46	3.47	2.70	4.51	3.58	3.20

Total HAPs = sum of individual HAP lb/MMBtu or lb/hr

GE 7HA.03 Steady State ULSD		Case 67	Case 68	Case 69	Case 70	Case 71	Case 72	Case 73	Case 80	Case 81	Case 82
Performance and Emissions Data		ULSD	ULSD	ULSD	ULSD	ULSD	ULSD	ULSD	ULSD	ULSD	ULSD
Load		Base	Base	75% Load	50% Load	Base	75% Load	50% Load	Base	75% Load	63% Load
Wet compression		0	0	0	MECL	0	0	MECL	0	0	MECL
Evaporative Cooling		Evap On	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off	Evap Off
Ambient pressure	psia	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69
Ambient temperature	°F	59	59	59	59	54.6	54.6	54.6	-5	-5	-5
Ambient relative humidity	%	60	60	60	60	55	55	60	56	56	56
1,3-Butadine (lb/hr includes 40% control)	lb/MMBtu	1.60E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05
	lb/hr	3.80E-02	3.75E-02	2.92E-02	2.27E-02	3.80E-02	2.95E-02	2.30E-02	3.84E-02	3.04E-02	2.72E-02
Benzene (lb/hr includes 40% control)	lb/MMBtu	5.50E-05	5.50E-05	5.50E-05	5.50E-05	5.50E-05	5.50E-05	5.50E-05	5.50E-05	5.50E-05	5.50E-05
	lb/hr	1.31E-01	1.29E-01	1.00E-01	7.81E-02	1.30E-01	1.01E-01	7.90E-02	1.32E-01	1.05E-01	9.35E-02
Formaldehyde (lb/hr includes 40% control)	lb/MMBtu	2.80E-04	2.80E-04	2.80E-04	2.80E-04	2.80E-04	2.80E-04	2.80E-04	2.80E-04	2.80E-04	2.80E-04
	lb/hr	6.66E-01	6.57E-01	5.10E-01	3.98E-01	6.64E-01	5.16E-01	4.02E-01	6.71E-01	5.33E-01	4.76E-01
Naphthalene (lb/hr includes 40% control)	lb/MMBtu	3.50E-05	3.50E-05	3.50E-05	3.50E-05	3.50E-05	3.50E-05	3.50E-05	3.50E-05	3.50E-05	3.50E-05
	lb/hr	8.32E-02	8.21E-02	6.38E-02	4.97E-02	8.30E-02	6.45E-02	5.03E-02	8.39E-02	6.66E-02	5.95E-02
PAH (lb/hr includes 40% control)	lb/MMBtu	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05	4.00E-05
	lb/hr	9.51E-02	9.38E-02	7.29E-02	5.68E-02	9.49E-02	7.37E-02	5.75E-02	9.59E-02	7.61E-02	6.80E-02

Individual HAPs lb/MMBtu = from AP-42 Section 3.1, Table 3.1-4 (organic HAPs)

Individual Organic HAP lb/hr = lb/MMBtu * MMBtu/hr * (1 - 0.4)

40% control for organic HAPs from oxidation catalyst

Arsenic	lb/MMBtu	1.10E-05	1.10E-05	1.10E-05	1.10E-05	1.10E-05	1.10E-05	1.10E-05	1.10E-05	1.10E-05	1.10E-05
	lb/hr	4.36E-02	4.30E-02	3.34E-02	2.60E-02	4.35E-02	3.38E-02	2.63E-02	4.40E-02	3.49E-02	3.12E-02
Beryllium	lb/MMBtu	3.10E-07	3.10E-07	3.10E-07	3.10E-07	3.10E-07	3.10E-07	3.10E-07	3.10E-07	3.10E-07	3.10E-07
	lb/hr	1.23E-03	1.21E-03	9.41E-04	7.34E-04	1.23E-03	9.52E-04	7.42E-04	1.24E-03	9.83E-04	8.78E-04
Cadmium	lb/MMBtu	4.60E-06	4.60E-06	4.60E-06	4.60E-06	4.60E-06	4.60E-06	4.60E-06	4.60E-06	4.60E-06	4.60E-06
	lb/hr	1.82E-02	1.80E-02	1.40E-02	1.09E-02	1.82E-02	1.41E-02	1.10E-02	1.84E-02	1.46E-02	1.30E-02
Chromium	lb/MMBtu	1.10E-05	1.10E-05	1.10E-05	1.10E-05	1.10E-05	1.10E-05	1.10E-05	1.10E-05	1.10E-05	1.10E-05
	lb/hr	4.36E-02	4.30E-02	3.34E-02	2.60E-02	4.35E-02	3.38E-02	2.63E-02	4.40E-02	3.49E-02	3.12E-02
Lead	lb/MMBtu	1.40E-05	1.40E-05	1.40E-05	1.40E-05	1.40E-05	1.40E-05	1.40E-05	1.40E-05	1.40E-05	1.40E-05
	lb/hr	5.55E-02	5.47E-02	4.25E-02	3.31E-02	5.54E-02	4.30E-02	3.35E-02	5.59E-02	4.44E-02	3.97E-02
Manganese	lb/MMBtu	7.90E-04	7.90E-04	7.90E-04	7.90E-04	7.90E-04	7.90E-04	7.90E-04	7.90E-04	7.90E-04	7.90E-04
	lb/hr	3.13E+00	3.09E+00	2.40E+00	1.87E+00	3.12E+00	2.43E+00	1.89E+00	3.16E+00	2.51E+00	2.24E+00
Mercury	lb/MMBtu	1.20E-06	1.20E-06	1.20E-06	1.20E-06	1.20E-06	1.20E-06	1.20E-06	1.20E-06	1.20E-06	1.20E-06
	lb/hr	4.75E-03	4.69E-03	3.64E-03	2.84E-03	4.75E-03	3.69E-03	2.87E-03	4.80E-03	3.81E-03	3.40E-03
Nickel	lb/MMBtu	4.60E-06	4.60E-06	4.60E-06	4.60E-06	4.60E-06	4.60E-06	4.60E-06	4.60E-06	4.60E-06	4.60E-06
	lb/hr	1.82E-02	1.80E-02	1.40E-02	1.09E-02	1.82E-02	1.41E-02	1.10E-02	1.84E-02	1.46E-02	1.30E-02
Selenium	lb/MMBtu	2.50E-05	2.50E-05	2.50E-05	2.50E-05	2.50E-05	2.50E-05	2.50E-05	2.50E-05	2.50E-05	2.50E-05
	lb/hr	9.90E-02	9.77E-02	7.59E-02	5.92E-02	9.89E-02	7.68E-02	5.99E-02	9.99E-02	7.93E-02	7.08E-02

Individual HAPs lb/MMBtu = from AP-42 Section 3.1, Table3.1-5 (metallic HAPs)

Individual Metallic HAP lb/hr = lb/MMBtu * MMBtu/hr

NRG Astoria Turbine Replacement Project

H-Class Turbine Startup/Shutdown Emissions

Natural Gas Fuel Only

Per Gas Turbine Stack	NOx (lbs/event)	CO (lbs/event)	VOCs as Methane (lbs/event)	Total PM (lbs/event)	Heat Input (MMBtu, HHV)
Start-Up (Normal)	175.0	140.0	44	9.4	1302
Start-up (Peaking Fast Start)	195.0	105.0	35	9.0	1628
Shut-Down	57.5	100.0	28	6.3	649
Gas SU/SD Cycle (max of SU + SD)	**252.5**	**240.0**	**72**	**15.7**	**2277**

Ultra Low Surfur Diesel Fuel Only

Per Gas Turbine Stack	NOx (lbs/event)	CO (lbs/event)	VOCs as Methane (lbs/event)	Total PM (lbs/event)	Heat Input (MMBtu, HHV)
Start-Up (Normal)	230	430.0	98	25.0	1343
Start-up (Peaking Fast Start)	230	305.0	70	25.0	1697
Shut-Down	117	221.0	50	19.0	650
ULSD SU/SD Cycle (max of SU + SD)	**347**	**651.0**	**148**	**44.0**	**2347**

Startup/Shutdown Emissions	Gas Factor lb/MMBtu	Gas lb/SU	Gas lb/SD	lb Gas SU/SD Cycle	ULSD Factor lb/MMBtu	ULSD lb/SU	ULSD lb/SD	lb ULSD SU/SD Cycle
SO2	0.00140	2.29	0.91	**3.20**	0.0015	2.60	1.00	**3.60**
H2SO4	0.00092	1.50	0.60	**2.10**	0.00101	1.71	0.66	**2.37**
CO2e	118.98	193,698	77,189	**270,886**	162.845	276,335	105,812	**382,147**
Total HAPs	1.03E-03	1.67	0.40	**2.07**	1.29E-03	2.19	0.73	**2.91**
1,3-Butadine	4.30E-07	7.00E-04	1.67E-04	**0.00**	1.60E-05	2.72E-02	6.24E-03	**0.03**
Acetaldehyde	4.00E-05	6.51E-02	1.56E-02	**0.08**				
Acrolein	6.40E-06	1.04E-02	2.49E-03	**0.01**				
Benzene	1.20E-05	1.95E-02	4.67E-03	**0.02**	5.50E-05	9.33E-02	2.14E-02	**0.11**
Ethylbenzene	3.20E-05	5.21E-02	1.25E-02	**0.06**				
Formaldehyde	7.10E-04	1.16E+00	2.76E-01	**1.43**	2.80E-04	4.75E-01	1.09E-01	**0.58**
Naphthalene					3.50E-05	5.94E-02	1.36E-02	**0.07**
PAH	2.20E-06	3.58E-03	8.56E-04	**0.00**	4.00E-05	6.79E-02	1.56E-02	**0.08**
Propylene Oxide	2.90E-05	4.72E-02	1.13E-02	**0.06**				
Toluene	1.30E-04	2.12E-01	5.06E-02	**0.26**				
Xylenes	6.40E-05	1.04E-01	2.49E-02	**0.13**				
Arsenic					1.10E-05	1.87E-02	7.15E-03	**0.03**
Beryllium					3.10E-07	5.26E-04	2.01E-04	**0.00**
Cadmium					4.80E-06	8.15E-03	3.12E-03	**0.01**
Chromium					1.10E-05	1.87E-02	7.15E-03	**0.03**
Lead					1.40E-05	2.38E-02	9.10E-03	**0.03**
Manganese					7.90E-04	1.34E+00	5.13E-01	**1.85**
Mercury					1.20E-06	2.04E-03	7.80E-04	**0.00**
Nickel					4.60E-06	7.81E-03	2.99E-03	**0.01**
Selenium					2.50E-05	4.24E-02	1.62E-02	**0.06**

Gas and ULSD SU/SD Cycles for NOX, CO, VOC, PM, and heat inputs are the maximum of normal or peaking startup plus shutdown

SO2 and H2SO4 factors are the same for steady state operation

CO2e factors are based on the general equation CO2e = CO2 + (CH4 * 25) + (N2O * 298)

CO2 is based on 40 CFR Part 75, Equation G-4 Gas CO2 lb/MMBtu = 1040 * 44 / 385 ULSD CO2 lb/MMBtu = 1420 * 44 / 385

CH4 and N2O factors are based on 40 CFR Part 98, Table C-2 Natural gas CH4 = 0.001 lb/MMBtu N2O = 0.0001 lb/MMBtu

ULSD CH4 = 0.003 lb/MMBtu N2O = 0.0006 lb/MMBtu

CO2e factors for CH4 (25) and N2O (298) are based on proposed revision to Part 231-13.9, Table 9. See application text Section 2.5.

lb/shutdown emissions includes 40% for organic HAPs, lb/startup emissions does not include organic HAP control

Gas lb/SU = Gas Factor lb/MMBtu * Gas startup MMBtu

Gas lb/SD = Gas Factor lb/MMBtu * Gas shutdown MMBtu * (1-0.4)

ULSD lb/SU = Gas Factor lb/MMBtu * Gas startup MMBtu

ULSD lb/SD (organic HAPs) = Gas Factor lb/MMBtu * Gas shutdown MMBtu * (1-0.4)

ULSD lb/SD (GHG and metallic HAPs) = Gas Factor lb/MMBtu * Gas shutdown MMBtu

NRG Astoria Turbine Replacement Project
Emergency Generator - Caterpillar C18 engine

Value	Parameter/Units
500	Engine Output (kWe)
744	Engine Output [bhp (using full standby)]
555	Engine Output (kWm)
37	gallons/hr (from emissions data sheet)
5.00	MMBtu/hr @ 0.135 MMBtu/gal
500	Annual hours of operation

Pollutant	Emission Factors [1]		lb/hr	ton/yr
NOx	0.67	g/kWm-hr	0.82	0.205
VOC	0.19	g/kWm-hr	0.23	0.058
CO	3.5	g/kWm-hr	4.28	1.07
PM\PM10\PM2.5	0.03	g/kWm-hr	0.04	0.009
SO2	15	ppmw	0.008	0.002
H2SO4	15%	of SO2	0.0012	0.0003
CO2e	74.21	kg/MMBtu	817	204
Total HAPs	1.57E-03	lb/MMBtu	7.86E-03	1.97E-03
Acetaldehyde	2.52E-05	lb/MMBtu	1.26E-04	3.15E-05
Acrolein	7.88E-06	lb/MMBtu	3.94E-05	9.84E-06
Benzene	7.76E-04	lb/MMBtu	3.88E-03	9.69E-04
Formaldehyde	7.89E-05	lb/MMBtu	3.94E-04	9.85E-05
Naphthalene	1.30E-04	lb/MMBtu	6.49E-04	1.62E-04
Total PAH	2.12E-04	lb/MMBtu	1.06E-03	2.65E-04
Toluene	2.81E-04	lb/MMBtu	1.40E-03	3.51E-04
Xylene	1.93E-04	lb/MMBtu	9.64E-04	2.41E-04

Notes and sample calculations

NOx/CO/VOC/PM lb/hr = lb/kWm * kWm
SO2 lb/hr = 15 lb S /1,000,000 * 2 lb SO2/lb S * 7.1 lb/gal * 37 gal/hr
CO2e lb/hr = kg/MMBtu * MMBtu/hr * 2.20462 lb/kg
ton/yr = lb/hr * hrs/yr / 2,000 lb/ton

(1) NOx, VOC, PM are the Tier 4 final standards applicable to generators; CO is the Tier 4 standard (no different standard for generators); SO2 based on maximum sulfur content of 15 ppmw; CO2e based on 40 CFR Part 98. Total HAPs are sum of individual HAPs. Individual HAPs are based on AP-42 Section 3.4 (diesel engine > 600hp), Tables 3.4-3 and 3.4-4 (Naphthalene and PAH). Total PAH includes naphthalene.

NRG Astoria Turbine Replacement Project
John Deere engine / Clarke fire pump

Value	Parameter/Units
156.9	Engine Output (bhp)
117	Engine Output (kWm)
8.7	gallons/hr
1.17	MMBtu/hr @ 0.135 MMBtu/gal
500	Annual hours of operation

Pollutant	Emission Factors (1)		lb/hr	ton/yr
NOx	4	g/kWm-hr	1.03	0.26
VOC	0.15	g/kWm-hr	0.039	0.01
CO	5	g/kWm-hr	1.29	0.32
PM/PM10/PM2.5	0.3	g/kWm-hr	0.08	0.019
SO2	15	ppmw	0.002	0.0005
H2SO4	15%	of SO2	0.0003	0.0001
CO2e	74.21	kg/MMBtu	192	48
Total HAPs	3.87E-03	lb/MMBtu	4.55E-03	1.14E-03
1,3-Butadiene	3.91E-05	lb/MMBtu	4.59E-05	1.15E-05
Acetaldehyde	7.67E-04	lb/MMBtu	9.01E-04	2.25E-04
Acrolein	9.25E-05	lb/MMBtu	1.09E-04	2.72E-05
Benzene	9.33E-04	lb/MMBtu	1.10E-03	2.74E-04
Formaldehyde	1.18E-03	lb/MMBtu	1.39E-03	3.46E-04
Naphthalene	8.48E-05	lb/MMBtu	9.96E-05	2.49E-05
Total PAH	1.68E-04	lb/MMBtu	1.97E-04	4.93E-05
Toluene	4.09E-04	lb/MMBtu	4.80E-04	1.20E-04
Xylenes	2.85E-04	lb/MMBtu	3.35E-04	8.37E-05

Notes and sample calculations

NOx/CO/VOC/PM lb/hr = lb/kWm * kWm

SO2 lb/hr = 15 lb S /1,000,000 * 2 lb SO2/lb S * 7.1 lb/gal * 37 gal/hr

CO2e lb/hr = kg/MMBtu * MMBtu/hr * 2.20462 lb/kg

ton/yr = lb/hr * hrs/yr / 2,000 lb/ton

(1) NOx,CO, and PM are the NSPS Subpart IIII standards applicable to fire pumps; NOx based on full NOx + HC value; VOC based on certificate HC data; SO2 based on maximum sulfur content of 15 ppmw; CO2e based on 40 CFR Part 98. Total HAPs are sum of individual HAPs. Individual HAPs are based on AP-42 Section 3.3 (diesel engine < 600 hp),Table 3.3-2. Total PAH includes naphthalene.

NRG Astoria Turbine Replacement Project
John Deere engine / Clarke fire pump

Value	Parameter/Units
237.4	Engine Output (bhp)
177	Engine Output (kWm)
13.2	gallons/hr
1.78	MMBtu/hr @ 0.135 MMBtu/gal
500	Annual hours of operation

Pollutant	Emission Factors (1)		lb/hr	ton/yr
NOx	4	g/kWm-hr	1.56	0.39
VOC	0.12	g/kWm-hr	0.047	0.01
CO	3.5	g/kWm-hr	1.37	0.34
PM/PM10/PM2.5	0.2	g/kWm-hr	0.08	0.02
SO2	15	ppmw	0.003	0.0007
H2SO4	15%	of SO2	0.0004	0.0001
CO2e	74.21	kg/MMBtu	292	73
Total HAPs	3.87E-03	lb/MMBtu	6.90E-03	1.73E-03
1,3-Butadiene	3.91E-05	lb/MMBtu	6.97E-05	1.74E-05
Acetaldehyde	7.67E-04	lb/MMBtu	1.37E-03	3.42E-04
Acrolein	9.25E-05	lb/MMBtu	1.65E-04	4.12E-05
Benzene	9.33E-04	lb/MMBtu	1.66E-03	4.16E-04
Formaldehyde	1.18E-03	lb/MMBtu	2.10E-03	5.26E-04
Naphthalene	8.48E-05	lb/MMBtu	1.51E-04	3.78E-05
Total PAH	1.68E-04	lb/MMBtu	2.99E-04	7.48E-05
Toluene	4.09E-04	lb/MMBtu	7.29E-04	1.82E-04
Xylenes	2.85E-04	lb/MMBtu	5.08E-04	1.27E-04

Notes and sample calculations

NOx/CO/VOC/PM lb/hr = lb/kWm * kWm
SO2 lb/hr = 15 lb S /1,000,000 * 2 lb SO2/lb S * 7.1 lb/gal * 37 gal/hr
CO2e lb/hr = kg/MMBtu * MMBtu/hr * 2.20462 lb/kg
ton/yr = lb/hr * hrs/yr / 2,000 lb/ton

(1) NOx,CO, and PM are the NSPS Subpart IIII standards applicable to fire pumps; NOx based on full NOx + HC value; VOC based on certificate HC data; SO2 based on maximum sulfur content of 15 ppmw; CO2e based on 40 CFR Part 98. Total HAPs are sum of individual HAPs. Individual HAPs are based on AP-42 Section 3.3 (diesel engine < 600 hp),Table 3.3-2. Total PAH includes naphthalene.

NRG Astoria Turbine Replacement Project
Fugitive Emissions

Estiamted Fugitive SF6 from Circuit Breakers

New breaker capacity	150	kg SF6 (total)
*	2.20462	lb/kg
	330.7	lbs SF6
*	0.5%	Annual leak rate (1)
	1.6535	lbs SF6
*	22,800	CO2e factor for SF6
	37,700	lbs CO2e
/	2,000	lb/ton
Estimated fugitive CO2e	18.8	tons CO2e

(1) Annual leak rate based on standard for SF6 leak rate from electrical equipment

Estimated Fugitive CH4 from Natural Gas Components

Component	Component Number(1)	Emission Factor(2) scf/hr/comp.	CO2e(3) ton/yr
Connectors	110	1.69	861.6
Block Valves	30	0.557	77.5
Control Valves	40	9.34	1,731.6
Orifice Meters	4	0.212	3.9
Regulators	4	0.772	14.3
Estimated fugitive CO2e			**2,689.0**

CO2e ton/yr = number * scf/hr/comp. factor * 8,760 hr/yr * 0.0192 kg CH4/scf * 2.20462 lb/kg * 25 CO2e/CH4 / 2,000 lb/ton

(1) Number of components are not repersentative of any specific facility design
(2) Factors based on 40 CFR Part 98, Table W-7 for Natural Gas Distribution
(3) CO2e based on 100% methane and GWP of 25 based on proposed revision to Part 231-13.9, Table 9. See application text Section 2.5.
(4) Methane density 0.0192 kg CH4/scf based on 40 CFR Part 98, Subpart W, equation W-36

TankSummaries for 2023 Annual

Site: NRG Astoria,

Equations for this site: After 2019 AP-42 revisions H/D ratio: Default 0.5

Tank ID	Fixed Roof Type	Diameter (ft)	Height (ft)	Max. Liquid Level (ft)	Inside Shell Condition	Shell Condition (post-19)	Shell Finish	Roof Condition (post-19)	Roof Finish	Product	Throughput (gal)	Avg. Liquid Surface Temp. (degF)	Bulk Liquid Temperature (degF)	Avg. TVP (psia)	Estimated VOC standing losses (lbs)	Estimated VOC working losses (lbs)	Total estimated VOC emissions (lbs)	Total estimated HAP emissions (lbs)
ULSD Tank_K1	A	84.25	48	47	L	Ag	J	Ag	K	Distillate fuel oil no. 2	11,006,000	59.942565	58.029942	0.00646975	252.5	220.8	473.3	41.7
ULSD Tank_K2	A	84.25	48	47	L	Ag	J	Ag	J	Distillate fuel oil no. 2	11,006,000	60.58418	58.029942	0.00660798	294.2	225.0	519.2	45.7
ULSK Tank	D	8	21.5	6	L	Av	H	Av	H	Kerosene	45,000	63.492834	59.313172	0.00923283	2.4	1.3	3.7	0.6

NRG Astoria Replacement Project
P&W Units 4-1A and 4-2B (to be used for black start)

Hours of operation	12	hrs/yr/turbine
Fuel	N. Gas or ULSK	
Heat Input (full load)	255	mmBtu/hr/turbine

	Emission Factor (lb/mmBtu)[1]				
Pollutant	Natural Gas	ULSK	lb/hr/turbine[2]	ton/yr/turbine	tons/yr
NOx	0.487	0.977	249.14	1.49	2.99
VOC	0.0021	0.00041	0.536	0.003	0.006
CO	0.386	0.0761	98.43	0.59	1.18
PM/PM10/PM2.5	0.0066	0.035	8.93	0.05	0.11
SO2	0.0034	0.0012	0.87	0.005	0.010
CO2e	110.12	157.56	40,178	241.07	482.13
Total HAPs	1.03E-03	1.29E-03	0.515	0.003	0.006
1,3-Butadine	4.30E-07	1.60E-05	4.08E-03	2.45E-05	4.90E-05
Acetaldehyde	4.00E-05		1.02E-02	6.12E-05	1.22E-04
Acrolein	6.40E-06		1.63E-03	9.79E-06	1.96E-05
Benzene	1.20E-05	5.50E-05	1.40E-02	8.42E-05	1.68E-04
Ethylbenzene	3.20E-05		8.16E-03	4.90E-05	9.79E-05
Formaldehyde	7.10E-04	2.80E-04	1.81E-01	1.09E-03	2.17E-03
Naphthalene		3.50E-05	8.93E-03	5.36E-05	1.07E-04
PAH	2.20E-06	4.00E-05	1.02E-02	6.12E-05	1.22E-04
Propylene Oxide	2.90E-05		7.40E-03	4.44E-05	8.87E-05
Toluene	1.30E-04		3.32E-02	1.99E-04	3.98E-04
Xylenes	6.40E-05		1.63E-02	9.79E-05	1.96E-04
Arsenic		1.10E-05	2.81E-03	1.68E-05	3.37E-05
Beryllium		3.10E-07	7.91E-05	4.74E-07	9.49E-07
Cadmium		4.60E-06	1.17E-03	7.04E-06	1.41E-05
Chromium		1.10E-05	2.81E-03	1.68E-05	3.37E-05
Lead		1.40E-05	3.57E-03	2.14E-05	4.28E-05
Manganese		7.90E-04	2.01E-01	1.21E-03	2.42E-03
Mercury		1.20E-06	3.06E-04	1.84E-06	3.67E-06
Nickel		4.60E-06	1.17E-03	7.04E-06	1.41E-05
Selenium		2.50E-05	6.38E-03	3.83E-05	7.65E-05

Notes and sample calculations

lb/hr/turbine = maximum lb/MMBtu of natural gas or ULSD * 255 MMBtu/hr

ton/yr/turbine = lb/hr/turbine * 12 hrs/hr / 2,000 lb/ton

tons/yr = ton/yr/turbine * 2 turbines

[1] Data from 2018 NRG Annual Emission Statement except for NOx; values for NOx taken from NOx RACT Averaging Plan

[2] Based on the use of the higher emission factor for natural gas or ULSK/ULSD

PERFORMANCE DATA [C18DE9D]

Perf No: EM1017 **Change Level:** 03

General Heat Rejection Emissions Regulatory Altitude Derate Cross Reference Perf Param Ref

View PDF

SALES MODEL:	C18	**COMBUSTION:**	DI
BRAND:	CAT	**ENGINE SPEED (RPM):**	1,800
ENGINE POWER (BHP):	779	**HERTZ:**	60
GEN POWER WITH FAN (EKW):	500.0	**FAN POWER (HP):**	32.2
COMPRESSION RATIO:	16.1	**ADDITIONAL PARASITICS (HP):**	2.7
RATING LEVEL:	STANDBY	**ASPIRATION:**	TA
PUMP QUANTITY:	1	**AFTERCOOLER TYPE:**	ATAAC
FUEL TYPE:	DIESEL	**AFTERCOOLER CIRCUIT TYPE:**	JW+OC, ATAAC
MANIFOLD TYPE:	DRY	**INLET MANIFOLD AIR TEMP (F):**	127
GOVERNOR TYPE:	ELEC	**JACKET WATER TEMP (F):**	192.2
ELECTRONICS TYPE:	ADEM4	**TURBO CONFIGURATION:**	SINGLE
CAMSHAFT TYPE:	STANDARD	**TURBO QUANTITY:**	1
IGNITION TYPE:	CI	**TURBOCHARGER MODEL:**	S430S 0.88 A/R VOF
INJECTOR TYPE:	EUI	**CERTIFICATION YEAR:**	2015
REF EXH STACK DIAMETER (IN):	6	**PISTON SPD @ RATED ENG SPD (FT/MIN):**	2,161.4
MAX OPERATING ALTITUDE (FT):	3,002		

INDUSTRY	SUB INDUSTRY	APPLICATION
ELECTRIC POWER	STANDARD	PACKAGED GENSET

General Performance Data Top

Note(s)

INLET MANIFOLD AIR TEMPERATURE ("INLET MFLD TEMP") FOR THIS CONFIGURATION IS MEASURED AT THE OUTLET OF THE AFTERCOOLER.

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	BRAKE MEAN EFF PRES (BMEP)	BRAKE SPEC FUEL CONSUMPTN (BSFC)	VOL FUEL CONSUMPTN (VFC)	INLET MFLD PRES	INLET MFLD TEMP	EXH MFLD TEMP	EXH MFLD PRES	ENGINE OUTLET TEMP
EKW	%	BHP	PSI	LB/BHP-HR	GAL/HR	IN-HG	DEG F	DEG F	IN-HG	DEG F
500.0	100	744	296	0.348	37.0	69.3	122.2	1,261.4	86.5	836.8
450.0	90	673	267	0.349	33.5	63.8	122.1	1,208.5	79.6	799.7
400.0	80	601	239	0.348	29.9	57.8	122.1	1,152.4	72.0	761.9
375.0	75	566	225	0.349	28.2	54.7	122.1	1,125.7	68.2	744.2
350.0	70	530	211	0.350	26.5	51.5	122.1	1,100.2	64.4	727.6
300.0	60	460	183	0.354	23.2	45.2	122.0	1,048.6	56.7	694.6
250.0	50	390	155	0.360	20.1	38.6	122.0	993.0	49.1	659.8
200.0	40	321	128	0.370	17.0	31.6	121.7	930.1	41.7	620.8
150.0	30	252	100	0.386	13.9	24.9	121.2	856.8	34.2	576.1
125.0	25	218	87	0.400	12.4	21.8	120.9	815.8	30.5	551.4
100.0	20	182	73	0.419	10.9	18.9	120.0	769.5	27.2	523.9
50.0	10	110	44	0.506	7.9	14.1	114.9	654.1	23.6	456.8

ENGINE	WET	WET	WET EXH	DRY EXH

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	COMPRESSOR OUTLET PRES	COMPRESSOR OUTLET TEMP	WET INLET AIR VOL FLOW RATE	OUTLET WET EXH GAS VOL FLOW RATE	INLET AIR MASS FLOW RATE	EXH GAS MASS FLOW RATE	VOL FLOW RATE (32 DEG F AND 29.98 IN HG)	VOL FLOW RATE (32 DEG F AND 29.98 IN HG)
EKW	%	BHP	IN-HG	DEG F	CFM	CFM	LB/HR	LB/HR	FT3/MIN	FT3/MIN
500.0	100	744	76	401.6	1,340.0	2,465.3	5,817.5	6,076.5	934.9	843.1
450.0	90	673	70	382.0	1,282.0	2,350.9	5,554.9	5,788.7	917.8	831.6
400.0	80	601	64	360.3	1,211.3	2,221.8	5,237.0	5,446.2	894.3	813.8
375.0	75	566	60	349.3	1,173.9	2,156.0	5,069.8	5,267.1	880.5	802.8
350.0	70	530	57	338.1	1,135.6	2,089.2	4,899.2	5,084.7	865.2	790.2
300.0	60	460	50	315.1	1,056.3	1,949.9	4,547.3	4,709.8	830.6	761.4
250.0	50	390	43	290.8	972.6	1,801.9	4,177.8	4,318.1	791.4	728.3
200.0	40	321	36	261.7	871.7	1,621.2	3,735.6	3,854.2	737.7	682.0
150.0	30	252	29	232.7	780.5	1,440.5	3,336.9	3,434.4	683.8	635.7
125.0	25	218	25	218.8	742.6	1,354.0	3,171.5	3,258.4	658.4	614.1
100.0	20	182	22	205.9	714.2	1,274.2	3,047.2	3,123.6	637.0	596.4
50.0	10	110	18	183.4	688.2	1,136.5	2,933.1	2,988.7	609.7	577.6

Heat Rejection Data Top

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	REJECTION TO JACKET WATER	REJECTION TO ATMOSPHERE	REJECTION TO EXH	EXHUAST RECOVERY TO 350F	FROM OIL COOLER	FROM AFTERCOOLER	WORK ENERGY	LOW HEAT VALUE ENERGY	HIGH HEAT VALUE ENERGY
EKW	%	BHP	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN
500.0	100	744	16,038	5,739	24,758	12,589	4,231	6,509	31,568	79,429	84,612
450.0	90	673	14,560	5,356	22,331	11,023	3,827	5,781	28,519	71,857	76,546
400.0	80	601	13,203	4,843	19,835	9,453	3,419	4,995	25,499	64,187	68,376
375.0	75	566	12,567	4,609	18,654	8,732	3,222	4,613	23,998	60,493	64,440
350.0	70	530	11,954	4,397	17,522	8,056	3,030	4,239	22,495	56,894	60,607
300.0	60	460	10,771	3,992	15,335	6,779	2,656	3,515	19,509	49,869	53,123
250.0	50	390	9,626	3,651	13,207	5,563	2,292	2,825	16,539	43,040	45,848
200.0	40	321	8,495	3,583	10,986	4,318	1,939	2,095	13,629	36,413	38,788
150.0	30	252	7,376	3,338	8,946	3,194	1,593	1,490	10,707	29,906	31,858
125.0	25	218	6,818	3,097	8,025	2,691	1,421	1,243	9,230	26,674	28,414
100.0	20	182	6,239	2,779	7,179	2,218	1,249	1,048	7,733	23,449	24,979
50.0	10	110	4,839	2,191	5,647	1,288	907	804	4,660	17,030	18,141

Emissions Data Top

Units Filter All Units

RATED SPEED POTENTIAL SITE VARIATION: 1800 RPM

GENSET POWER WITH FAN ENGINE POWER		EKW BHP	500.0 744	375.0 566	250.0 390	125.0 218	50.0 110
PERCENT LOAD		%	100	75	50	25	10
TOTAL NOX (AS NO2)		G/HR	232	225	70	22	53
TOTAL CO		G/HR	0	0	0	0	0
TOTAL HC		G/HR	20	8	0	0	0
PART MATTER		G/HR	16.6	7.8	5.0	3.2	2.1
TOTAL NOX (AS NO2)	(CORR 5% O2)	MG/NM3	144.8	183.4	80.3	45.3	188.2
TOTAL CO	(CORR 5% O2)	MG/NM3	0.0	0.0	0.0	0.0	0.1
TOTAL HC	(CORR 5% O2)	MG/NM3	10.5	5.4	0.0	0.0	0.0
PART MATTER	(CORR 5% O2)	MG/NM3	8.3	5.3	4.9	5.3	5.8
TOTAL NOX (AS NO2)	(CORR 5% O2)	PPM	71	89	39	22	92
TOTAL CO	(CORR 5% O2)	PPM	0	0	0	0	0
TOTAL HC	(CORR 5% O2)	PPM	20	10	0	0	0
TOTAL NOX (AS NO2)		G/HP-HR	0.31	0.40	0.18	0.10	0.49
TOTAL CO		G/HP-HR	0.00	0.00	0.00	0.00	0.00
TOTAL HC		G/HP-HR	0.03	0.01	0.00	0.00	0.00
PART MATTER		G/HP-HR	0.02	0.01	0.01	0.01	0.02

TOTAL NOX (AS NO2)		LB/HR	0.51	0.50	0.15	0.05	0.12
TOTAL CO		LB/HR	0.00	0.00	0.00	0.00	0.00
TOTAL HC		LB/HR	0.04	0.02	0.00	0.00	0.00
PART MATTER		LB/HR	0.04	0.02	0.01	0.01	0.00

RATED SPEED NOMINAL DATA: 1800 RPM

GENSET POWER WITH FAN **ENGINE POWER**		**EKW** **BHP**	**500.0** **744**	**375.0** **566**	**250.0** **390**	**125.0** **218**	**50.0** **110**
PERCENT LOAD		**%**	**100**	**75**	**50**	**25**	**10**
TOTAL NOX (AS NO2)		G/HR	161	156	48	15	37
TOTAL CO		G/HR	0	0	0	0	0
TOTAL HC		G/HR	9	4	0	0	0
TOTAL CO2		KG/HR	375	285	203	125	80
PART MATTER		G/HR	4.3	2.0	1.3	0.8	0.6
TOTAL NOX (AS NO2)	(CORR 5% O2)	MG/NM3	100.5	127.4	55.8	31.4	130.7
TOTAL CO	(CORR 5% O2)	MG/NM3	0.0	0.0	0.0	0.0	0.0
TOTAL HC	(CORR 5% O2)	MG/NM3	4.9	2.5	0.0	0.0	0.0
PART MATTER	(CORR 5% O2)	MG/NM3	2.2	1.4	1.3	1.4	1.5
TOTAL NOX (AS NO2)	(CORR 5% O2)	PPM	49	62	27	15	64
TOTAL CO	(CORR 5% O2)	PPM	0	0	0	0	0
TOTAL HC	(CORR 5% O2)	PPM	9	5	0	0	0
FORMALDEHYDE	(CORR 15% O2)	PPM	0.00	0.00	0.00	0.03	0.01
ACROLEIN	(CORR 15% O2)	PPM	0.10	0.15	0.57	0.35	0.62
ACETALDEHYDE	(CORR 15% O2)	PPM	0.16	0.32	0.42	0.10	0.71
METHANOL	(CORR 15% O2)	PPM	0.00	0.07	0.03	0.00	0.00
NON-METHANE HC	(CORR 15% O2)	PPM	2.42	1.28	0.00	0.00	0.00
NON-ETHANE HC	(CORR 15% O2)	PPM	2.42	1.28	0.00	0.00	0.00
TOTAL NOX (AS NO2)		G/HP-HR	0.22	0.28	0.13	0.07	0.34
TOTAL CO		G/HP-HR	0.00	0.00	0.00	0.00	0.00
TOTAL HC		G/HP-HR	0.01	0.01	0.00	0.00	0.00
PART MATTER		G/HP-HR	0.01	0.00	0.00	0.00	0.01
TOTAL NOX (AS NO2)		LB/HR	0.36	0.34	0.11	0.03	0.08
TOTAL CO		LB/HR	0.00	0.00	0.00	0.00	0.00
TOTAL HC		LB/HR	0.02	0.01	0.00	0.00	0.00
TOTAL CO2		LB/HR	826	628	447	275	176
PART MATTER		LB/HR	0.01	0.00	0.00	0.00	0.00
OXYGEN IN EXH		%	7.6	9.5	11.1	13.2	15.7

Regulatory Information Top

EPA TIER 4 FINAL **2015 - ----**

GASEOUS EMISSIONS DATA MEASUREMENTS PROVIDED TO THE EPA ARE CONSISTENT WITH THOSE DESCRIBED IN EPA 40 CFR PART 1039 SUBPART F AND ISO 8178 FOR MEASURING HC, CO, PM, AND NOX. THE "MAX LIMITS" SHOWN BELOW ARE WEIGHTED CYCLE AVERAGES AND ARE IN COMPLIANCE WITH THE NON-ROAD REGULATIONS.

Locality	**Agency**	**Regulation**	**Tier/Stage**	**Max Limits - G/BKW - HR**
U.S. (INCL CALIF)	EPA	NON-ROAD GENSET	TIER 4 FINAL	CO: 3.5 NOx: 0.67 HC: 0.19 PM: 0.03

Altitude Derate Data Top

ALTITUDE CORRECTED POWER CAPABILITY (BHP)

AMBIENT OPERATING TEMP (F)	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**	**140**	**NORMAL**
ALTITUDE (FT)											
0	779	779	779	779	777	774	771	768	576	516	779
1,000	779	779	779	777	774	771	768	699	557	511	778
2,000	779	778	776	774	771	751	719	593	529	501	776
3,000	777	775	773	770	751	651	571	543	516	489	773
4,000	773	771	769	754	674	582	552	526	501	476	770

5,000	769	761	736	669	602	557	533	509	485	462	765
6,000	725	679	653	604	560	536	514	492	470	449	704
7,000	648	592	577	560	537	515	495	474	454	435	648
8,000	585	567	553	538	516	495	475	456	437	418	595
9,000	557	544	531	516	496	476	456	436	418	400	573
10,000	533	522	508	494	474	454	431	404	380	362	555
11,000	514	503	495	487	462	431	398	373	358	357	534
12,000	495	485	483	471	445	417	384	372	371	369	514
13,000	473	463	461	444	412	381	379	378	376	374	495
14,000	449	434	420	392	381	379	378	376	374	372	470
15,000	397	379	367	381	379	377	376	374	372	370	442

Cross Reference Top

Test Spec	Setting	Engine Arrangement	Engineering Model	Engineering Model Version	Start Effective Serial Number	End Effective Serial Number
4150867	PP7129	4190902	PS072	LS	CM800001	
4150867	PP7129	4190904	GS759	LS	CM800001	

Performance Parameter Reference Top

Parameters Reference: DM9600 - 09

PERFORMANCE DEFINITIONS

PERFORMANCE DEFINITIONS DM9600 APPLICATION: Engine performance tolerance values below are representative of a typical production engine tested in a calibrated dynamometer test cell at SAE J1995 standard reference conditions. Caterpillar maintains ISO9001:2000 certified quality management systems for engine test Facilities to assure accurate calibration of test equipment. Engine test data is corrected in accordance with SAE J1995. Additional reference material SAE J1228, J1349, ISO 8665, 3046-1:2002E, 3046-3:1989, 1585, 2534, 2288, and 9249 may apply in part or are similar to SAE J1995. Special engine rating request (SERR) test data shall be noted. PERFORMANCE PARAMETER TOLERANCE FACTORS (PLUS/MINUS): Power 3% Torque 3% Exhaust stack temperature 8% Inlet airflow 5% Intake manifold pressure-gage 10% Exhaust flow 6% Specific fuel consumption 3% Fuel rate 5% Specific DEF consumption 3% DEF rate 5% Heat rejection 5% Heat rejection exhaust only 10% Heat rejection CEM only 10% Heat Rejection values based on using treated water. Torque is included for truck and industrial applications, do not use for Gen Set or steady state applications. On C7 - C18 engines, at speeds of 1100 RPM and under these values are provided for reference only, and may not meet the tolerance listed. These values do not apply to C280/3600. For these models, see the tolerances listed below. C280/3600 HEAT REJECTION TOLERANCE FACTORS (PLUS/MINUS): Heat rejection 10% Heat rejection to Atmosphere 50% Heat rejection to Lube Oil 20% Heat rejection to Aftercooler 5% TEST CELL TRANSDUCER TOLERANCE FACTORS (PLUS/MINUS): Torque 0.5% Speed 0.2% Fuel flow 1.0% Temperature 2.0 C degrees Intake manifold pressure 0.1 kPa OBSERVED ENGINE PERFORMANCE IS CORRECTED TO SAE J1995 REFERENCE AIR AND FUEL CONDITIONS. REFERENCE ATMOSPHERIC INLET AIR FOR 3500 ENGINES AND SMALLER SAE J1228 AUG2002 for marine engines, and J1995 JAN2014 for other engines, reference atmospheric pressure is 100 KPA (29.61 in hg), and standard temperature is 25deg C (77 deg F) at 30% relative humidity at the stated aftercooler water temp, or inlet manifold temp. FOR 3600 ENGINES Engine rating obtained and presented in accordance with ISO 3046/1 and SAE J1995 JANJAN2014 reference atmospheric pressure is 100 KPA (29.61 in hg), and standard temperature is 25deg C (77 deg F) at 30% relative humidity and 150M altitude at the stated aftercooler water temperature. MEASUREMENT LOCATION FOR INLET AIR TEMPERATURE Location for air temperature measurement air cleaner inlet at stabilized operating conditions. REFERENCE EXHAUST STACK DIAMETER The Reference Exhaust Stack Diameter published with this dataset is only used for the calculation of Smoke Opacity values displayed in this dataset. This value does not necessarily represent the actual stack diameter of the engine due to the variety of exhaust stack adapter options available. Consult the price list, engine order or general dimension drawings for the actual stack diameter size ordered or options available. REFERENCE FUEL DIESEL Reference fuel is #2 distillate diesel with a 35API gravity; A lower heating value is 42,780 KJ/KG (18,390 BTU/LB) when used at 29 deg C (84.2 deg F), where the density is 838.9 G/Liter (7.001 Lbs/Gal). GAS Reference natural gas fuel has a lower heating value of 33.74 KJ/L (905 BTU/CU Ft). Low BTU ratings are based on 18.64 KJ/L (500 BTU/CU FT) lower heating value gas. Propane ratings are based on 87.56 KJ/L (2350 BTU/CU Ft) lower heating value gas. ENGINE POWER (NET) IS THE CORRECTED FLYWHEEL POWER (GROSS) LESS EXTERNAL AUXILIARY LOAD Engine corrected gross output includes the power required to drive standard equipment; lube oil, scavenge lube oil, fuel transfer, common rail fuel, separate circuit aftercooler and jacket water pumps. Engine net power available for the external (flywheel) load is calculated by subtracting the sum of auxiliary load from the corrected gross flywheel out put power. Typical auxiliary loads are radiator cooling fans, hydraulic pumps, air compressors and battery charging alternators. For Tier 4 ratings additional Parasitic losses would also include Intake, and Exhaust Restrictions. ALTITUDE CAPABILITY Altitude capability is the maximum altitude above sea level at standard temperature and standard pressure at which the engine could develop full rated output power on the current performance data set. Standard temperature values versus altitude could be seen on TM2001. When viewing the altitude capability chart the ambient temperature is the inlet air temp at the compressor inlet. Engines with ADEM MEUI and HEUI fuel systems operating at conditions above the defined altitude capability derate for atmospheric pressure and temperature conditions outside the values defined, see TM2001. Mechanical governor controlled unit injector engines require a setting change for operation at conditions above the altitude defined on the engine performance sheet. See your Caterpillar technical representative for non standard ratings. REGULATIONS AND PRODUCT COMPLIANCE TMI Emissions information is presented at 'nominal' and 'Potential Site Variation' values for standard ratings. No tolerances are applied to the emissions data. These values are subject to change at any time. The controlling federal and local emission requirements need to be verified by your Caterpillar technical representative. Customer's may have special emission site requirements that need to be verified by the Caterpillar Product Group engineer. EMISSIONS DEFINITIONS: Emissions : DM1176 HEAT REJECTION DEFINITIONS: Diesel Circuit Type and HHV Balance : DM9500 HIGH DISPLACEMENT (HD) DEFINITIONS: 3500: EM1500 RATING DEFINITIONS: Agriculture : TM6008 Fire Pump : TM6009 Generator Set : TM6035 Generator (Gas) : TM6041 Industrial Diesel : TM6010 Industrial (Gas) : TM6040 Irrigation : TM5749 Locomotive : TM6037 Marine Auxiliary : TM6036 Marine Prop (Except 3600) : TM5747 Marine Prop (3600 only) : TM5748 MSHA : TM6042 Oil Field (Petroleum) : TM6011 Off-Highway Truck : TM6039 On-Highway Truck : TM6038 SOUND DEFINITIONS: Sound Power : DM8702 Sound Pressure : TM7080

CLARKE®

Rating Specific Emissions Data

Nameplate Rating Information

Clarke Model	**JU4H-UFADW8**
Power Rating (BHP/kW)	**144/107**
Certified Speed (RPM)	**1760**

Refer to **Rating Data** section on page 2 for emissions output values

Rating Specific Emissions Data - John Deere Power Systems

JOHN DEERE

Rating Data

Rating	4045HFC28A	
Certified Power(kW)	117	
Rated Speed	1760	
Vehicle Model Number	OEM (Clarke Fire Pump-Emergency)	
Units	g/kW-hr	g/hp-hr
NOx	3.70	2.76
HC	0.12	0.09
NOx + HC	N/A	N/A
Pm	0.12	0.09
CO	1.3	1.0

Certificate Data

Engine Model Year	2019
EPA Family Name	KJDXL04.5119
EPA JD Name	350HAJ
EPA Certificate Number	KJDXL04.5119-004
CARB Executive Order	
Parent of Family	4045HFG82A
Units	g/kW-hr
NOx	3.36
HC	0.15
NOx + HC	N/A
Pm	0.17
CO	1.3

* The emission data listed is measured from a laboratory test engine according to the test procedures of 40 CFR 89 or 40 CFR 1039, as applicable. The test engine is intended to represent nominal production hardware, and we do not guarantee that every production engine will have identical test results. The family parent data represents multiple ratings and this data may have been collected at a different engine speed and load. Emission results may vary due to engine manufacturing tolerances, engine operating conditions, fuels used, or other conditions beyond our control.

Emissions Results by Rating run on Feb-18-2019

Rating Specific Emissions Data

Nameplate Rating Information

Clarke Model	**JU6H-UFADNG**
Power Rating (BHP/kW)	**190/142**
Certified Speed (RPM)	**1760**

Refer to **Rating Data** section on page 2 for emissions output values

Rating Specific Emissions Data - John Deere Power Systems

JOHN DEERE

Rating Data

Rating	6068HFC28A	
Certified Power(kW)	177	
Rated Speed	1760	
Vehicle Model Number	OEM (Clarke Fire Pump-Emergency)	
Units	g/kW-hr	g/hp-hr
NOx	3.62	2.70
HC	0.16	0.12
NOx + HC	N/A	N/A
Pm	0.13	0.10
CO	1.2	0.9

Certificate Data

Engine Model Year	2019
EPA Family Name	KJDXL06.8120
EPA JD Name	350HAK
EPA Certificate Number	KJDXL06.8120-003
CARB Executive Order	
Parent of Family	6068HFG82A
Units	g/kW-hr
NOx	3.79
HC	0.12
NOx + HC	N/A
Pm	0.12
CO	1.2

* The emission data listed is measured from a laboratory test engine according to the test procedures of 40 CFR 89 or 40 CFR 1039, as applicable. The test engine is intended to represent nominal production hardware, and we do not guarantee that every production engine will have identical test results. The family parent data represents multiple ratings and this data may have been collected at a different engine speed and load. Emission results may vary due to engine manufacturing tolerances, engine operating conditions, fuels used, or other conditions beyond our control.

Emissions Results by Rating run on Feb-18-2019

Appendix D

Supporting BACT Information

Table D-1: Summary of Recent PM/PM10/PM2.5 BACT and LAER Determination for Simple Cycle Generating Plants

Facility	Location	Permit Date	Turbine Make & Model	Emission Limits (for natural gas firing unless otherwise noted)	Control(s)
LBWL Erickson Station	Eaton, MI	12/21/2018	667 MMBtu/hr	4.5 lb/hr (0.0675 lb/MMBtu)	Pipeline quality natural gas, inlet air conditioning, and good combustion practices
Rio Bravo Pipeline Facility	Cameron County, TX	12/17/2018	GE 7EA, 967 MMBtu/hr	7 lb/hr (0.0072 lb/MMBtu)	Pipeline quality natural gas and good combustion practices
Calcasieu Pass LNG Project	Cameron County, LA	09/21/2018	927 MMBtu/hr	8 lb/hr (0.0086 lb/MMBtu)	Exclusive combustion for fuel gas and good combustion practices including burner design
Washington Parish Energy Center	Washington Parish, LA	05/23/18	180 MW, 2,201 MMBtu/hr	6.3 lb/hr (0.003 lb/MMBtu)	Pipeline quality natural gas
Waverly Power Plant	Pleasants County, WV	03/13/18	GE 7FA.004	15.09 lb/hr (0.008 lb/MMBtu)	Pipeline quality natural gas
Jackson County Generating	Jackson County, TX	01/26/18	Siemens SGT6-5000F5	11.8 tpy	Pipeline quality natural gas
Mustang Station	Yoakum County, TX	08/16/2017	GE 7FA	27 ton/yr, 3,000 hr/yr	Pipeline quality natural gas and good combustion practices
NRG Canal 3	Sandwich, MA	08/04/17	GE 7HA.02	0.0073 lb/MMBtu (gas ≥75% load) 0.012 lb/MMBtu (gas <75% load) 0.026 lb/MMBtu (ULSD ≥75% load) 0.046 lb/MMBtu (ULSD <75% load)	Clean fuels and good combustion practices
Gaines County Power	Gaines County, TX	04/28/17	Siemens SGT6-5000F5	8.5 tpy	Pipeline quality natural gas
Vermillion Generating	Vermillion County, IN	02/28/17	GE 7EA	5.0 lb/hr (0.004 lb/MMBtu)	Good combustion practices
Montpelier Generating	Wells County, IN	01/06/17	Pratt & Whitney Twin-Pac	0.0066 lb/MMBtu (gas) 0.012 lb/MMBtu (ULSD)	Clean fuels and good combustion practices
West Medway Generating	Medway, MA	12/19/16	GE LMS 100	0.018 lb/MMBtu (gas) 0.032 lb/MMBtu (ULSD)	Clean fuels and good combustion practices
Puente Power	Ventura, CA	10/13/16	GE 7HA.01	10.1 lb/hr (0.004 lb/MMBtu)	Natural gas and good combustion practices

Table D-1: Summary of Recent PM/PM10/PM2.5 BACT and LAER Determination for Simple Cycle Generating Plants

Facility	Location	Permit Date	Turbine Make & Model	Emission Limits (for natural gas firing unless otherwise noted)	Control(s)
Doswell Energy Center	Hanover County. VA	10/4/2016	GE 7FA, 1,961 MMBtu/hr	12 lb/hr (0.0062 lb/MMBtu)	Good combustion, operation and maintenance practices and use of pipeline quality natural gas
Nelson Generating	Lee, IL	09/27/16	GE 7FA	0.005 lb/MMBtu (gas) 0.020 lb/MMBtu (ULSD)	Clean fuels and good combustion practices
Bayonne Energy Center	Hudson County, NJ	08/26/16	Rolls Royce Trent 64 MW	5.0 lb/hr (gas) (0.009 lb/MMBtu) 14.0 lb/hr (ULSD) (0.028 lb/MMBtu)	Good combustion practices
Hill County Generating	Hill County, TX	04/07/16	GE 7FA.03, GE 7FA.04, GE 7FA.05, or Siemens SGT6-5000	14.0 lb/hr (0.006 lb/MMBtu)	Good combustion practices
Neches Station	Cherokee County, TX	03/24/16	Siemens SGT6-5000F5 or GE 7FA.05	13.4 lb/hr (0.006 lb/MMBtu)	Good combustion practices
Navasota South Union Valley Energy Center	Nixon County TX	12/9/15	GE 7FA.04	8.6 lb/hr (0.005 lb/MMBtu)	Pipeline quality natural gas
Shawnee Energy Center	Hill County, TX	11/10/15	Siemens SGT6-5000F5 or GE 7FA.05	84.1 lb/hr (0.04 lb/MMBtu)	Natural gas and good combustion practices
Navasota North Van Alstyne Energy Center	Grayson County TX	10/27/15	GE 7FA.04	8.6 lb/hr (0.005 lb/MMBtu)	Pipeline quality natural gas
Nacogdoches Power LLC	Nacogdoches County TX	10/14/15	Siemens SGT6-5000F5	12.09 lb/hr (0.005 lb/MMBtu)	Natural gas and good combustion practices
FPL Fort Myers Plant	Lee County, FL	09/10/15	GE 7F.05	2.0 gr. S/100 scf & 0.0015% sulfur fuel oil	Natural gas as primary fuel & ULSD
FPL Lauderdale Plant	Broward County, FL	08/25/15	GE 7F.05	2.0 gr. S/100 scf & 0.0015% sulfur fuel oil	Natural gas as primary fuel & ULSD
Goldenspread Antelope Elk Energy	Hale County, TX	05/12/15	GE 7FA.05	NA	Pipeline quality natural gas
Duke Suwannee River Power Plant	Live Oak, FL	04/28/15	GE 7FA.03	2.0 gr. S/100 scf & 0.0015% sulfur fuel oil	Natural gas as primary fuel & ULSD
Black Hills - Pueblo Airport Generating	Pueblo, CO	12/11/14	GE LMS100	6.6 lb/hr (0.008 lb/MMBtu)	Natural gas as primary fuel

Table D-1: Summary of Recent PM/PM10/PM2.5 BACT and LAER Determination for Simple Cycle Generating Plants

Facility	Location	Permit Date	Turbine Make & Model	Emission Limits (for natural gas firing unless otherwise noted)	Control(s)
Tenaska Roan's Prairie Partners	Grimes, TX	09/22/14	GE 7FA.04, GE 7FA.05 or Siemens SGT6-5000F	9.3 lb/hr (GE, 0.005 lb/MMBtu) 10 lb/hr (Siemens, 0.005 lb/MMBtu)	Natural gas as primary fuel
Perryman Generating	Harford County, MD	07/01/14	Pratt & Whitney Twin-Pac	0.0079 lb/MMBtu	Natural gas as primary fuel, and Good combustion
Troutdale Energy Center	Multnomah, OR	03/05/14	GE LMS-100	9.1 lb/hr (gas) (0.01 lb/MMBtu) 22.74 lb/hr (oil) (0.03 lb/MMBtu)	Natural gas as primary fuel
Basin EPC Lonesome Creek Generating Station	McKenzie, ND	09/16/13	GE LM6000 PF Sprint	5.0 lb/hr (0.012 lb/MMBtu)	Natural gas as primary fuel
Basin EPC Pioneer Generating Station	Williams, ND	05/14/13	GE LM6000 PF Sprint	5.4 lb/hr (0.012 lb/MMBtu)	Natural gas as primary fuel
Montana-Dakota Utilities Co. R.M. Heskett Station	Morton, ND	02/22/13	GE Model PG 7121 (7EA)	7.3 lb/hr (0.007 lb/MMBtu)	Natural gas as primary fuel, and Good combustion
Pio Pico Energy Center	Otay Mesa, CA	11/19/12	GE LMS100	0.0065 lb/MMBtu (>80%)	Natural gas as primary fuel
Black Hills Power, Inc. - Cheyenne Prairie Generating Station	Laramie, WY	08/28/12	GE LM6000	4.0 lb/hr (0.010 lb/MMBtu)	Natural gas as primary fuel, Good combustion
EFS Shady Hills	Pasco County FL	04/06/12	GE 7FA.05	2.0 gr. S/100 scf & 0.0015% sulfur fuel oil	Good combustion

Table D-2: Summary of Recent GHG BACT Determinations for Simple-Cycle Generating Plants

Facility	Location	Permit Date	Turbine Make & Model	Emission Limits (for natural gas firing unless otherwise noted)	Control(s)
Calcasieu Pass LNG Project	Cameron County, LA	6/25/2018	927 MMBtu/hr	1,426,146 ton CO_{2e}/yr	Exclusively combust low carbon fuel gas, good combustion practices, good operation and maintenance practices, and insulation
Washington Parish Energy Center	Washington Parish, LA	05/23/18	180 MW	120 lb CO_2/MMBtu (gas)	Natural gas
Waverly Power Plant	Pleasants County, WV	03/13/18	GE 7FA.004	1,300 lb CO_2e/MW-hr (gas) 1,900 lb CO_2e/MW-hr (oil)	Natural gas as primary fuel
Mustang Station	Yoakum County, TX	08/16/2017	GE 7FA	120 lb CO_2/MMBtu (gas)	Pipeline quality natural gas and good combustion practices
NRG Canal 3	Sandwich, MA	08/04/17	GE 7HA.02	1,178 lb CO_2/MW-hr (gas, gross) 1,673 lb CO_2/MW-hr (ULSD, gross)	Natural gas as primary fuel
Jackson County Generating Facility	Jackson County, TX	6/30/2017	Siemens F5	1,316 lb CO_2e/MW-hr (gas)	Energy efficiency designs, practices, and procedures, CT inlet air cooling, periodic CT burner maintenance and tuning, reduction in heat loss, i.e., insulation of the CT, instrumentation and controls
Gaines County Power	Gaines County, TX	04/28/17	Siemens SGT6-5000F5	1,300 lb CO_2e/MW-hr	Natural gas
Montpelier Generating	Wells County, IN	01/06/17	Pratt & Whitney Twin-Pac	118 lb CO_2/MMBtu (gas) 162 lb CO_2/MMBtu (ULSD)	Natural gas as primary fuel
West Medway Generating	Medway, MA	12/19/16	GE LMS 100	1,151 lb/MW-hr natural gas 1,551 lb/MW-hr ULSD 1,352 lb/MW-hr annual average (gross)	Natural gas as primary fuel
Nelson Generating	Lee, IL	09/27/16	GE 7FA	1,367 lb CO_2e/MW-hr (gross)	Natural gas
Hill County Generating	Hill County, TX	04/07/16	GE 7FA.03, GE 7FA.04, GE 7FA.05, or Siemens SGT6-5000	1,434 lb CO_2e/MW-hr	Natural gas

Table D-2: Summary of Recent GHG BACT Determinations for Simple-Cycle Generating Plants

Facility	Location	Permit Date	Turbine Make & Model	Emission Limits (for natural gas firing unless otherwise noted)	Control(s)
Neches Station	Cherokee County, TX	03/24/16	Siemens SGT6-5000F5 or GE 7FA.05	1,341 lb CO_2e/MW-hr	Natural gas
Navasota South Union Valley Energy Center	Nixon County TX	12/9/15	GE 7FA.04	1,461 lb CO_2e/MW-hr	Natural gas
Shawnee Energy Center	Hill County, TX	11/10/15	Siemens SGT6-5000F5 or GE 7FA.05	1,398 lb CO_2e/MW-hr	Natural gas
Navasota North Van Alstyne Energy Center	Grayson County TX	10/27/15	GE 7FA.04	1,461 lb CO_2e/MW-hr	Natural gas
NRG Cedar Bayou	Hill County, TX	09/15/15	GE 7HA, GE 7FA, Siemens SF5, or MHI 501G	1,232 lb CO_2e/MW-hr	Natural gas
FPL Fort Myers Plant	Lee County, FL	09/10/15	GE 7F.05	1,374 lb CO_2e/MW-hr (gas) 1,874 lb CO_2e/MW-hr (oil)	Natural gas as primary fuel
Goldenspread Antelope Elk Energy	Hale County, TX	05/12/15	GE 7FA.05	1,304 lb CO_2e/MW-hr	Natural gas
Duke Suwannee River Power Plant	Live Oak, FL	04/28/15	GE 7FA.03	1,409 lb CO_2e/MW-hr (gas) 1,973 lb CO_2e/MW-hr (oil)	Natural gas as primary fuel
Indeck Wharton Energy Center	Wharton, TX	02/02/15	Siemens SGT6-5000F or GE 7FA	1,337 lb CO_2/MW-hr (gross) (Siemens) 1,276 lb CO_2/MW-hr (gross) (GE)	Natural gas
Black Hills - Pueblo Airport Generating	Pueblo, CO	12/11/14	GE LMS100	1,600 lb CO_2e/MW-hr (365 day rolling avg)	Natural gas
Guadalupe Generating Station	Marion, TX	12/02/14	GE 7FA.05	1,276 lb CO_2/MW-hr (gross)	Natural gas
Tenaska Roan's Prairie Partners	Grimes, TX	09/22/14	GE 7FA.04, GE 7FA.05 or Siemens SGT6-5000F	1,334 lb CO_2/MW-hr (gross)	Natural gas
Perryman Generating	Harford County, MD	07/01/14	Pratt & Whitney Twin-Pac	1,394 lb CO_2e/MW-hr (gas) 1,741 lb CO_2e/MW-hr (oil)	Natural gas as primary fuel
Troutdale Energy Center	Multnomah, OR	03/05/14	GE LMS-100	1,741 lb CO_2e/MW-hr (365 day rolling avg)	Natural gas as primary fuel

Table D-3: Summary of Recent PSD BACT Determinations for Emergency Generator Engines at Simple-Cycle Generating Plants[1]

Facility	Location	Permit Date	Engine Size[1]	PM	GHGs
LBWL—Erickson Station	Eaton, MI	12/21/2018	1,500 hp	0.69 lb/hr (0.21 g/bhp-hr)	406 tpys
Calcasieu Pass LNG Project	Cameron County, LA	09/21/2018	634 kW	0.3 g/bhp-hr	1,481 tpy
NRG Canal 3	Sandwich, MA	08/04/17	500 kWe	0.03 g/kW- hr [2]	162.85 lb/MMBtu
Cameron LNG	Cameron, LA	2/17/2017	3,353 hp	Subpart III	N/A
West Medway Generating	Medway, MA	12/19/16	603 hp	Subpart III	128 tpy
Puente Power	Ventura, CA	10/13/16	779 hp	0.02 g/bhp-hr [3]	NA
Goldenspread Antelope Elk Energy	Hale, TX	05/12/15	1,656 kW	Subpart III	128 tpy
Carlsbad Energy Center	Carlsbad, CA	04/17/15	779 hp	Subpart III	128 tpy
Tenaska Roan's Prairie Partners	Grimes, TX	09/22/14	2,937 hp	Subpart III	156 tpy
Perryman Generating	Harford County, MD	07/01/14	1,300 hp	Subpart III	156 tpy
FP&L Lauderdale	Broward, FL	04/22/14	3,100 kW	Subpart III	N/A
Black Hills - Cheyenne Prairie Generating Station	Laramie, WY	08/28/12	839 hp	Subpart III	226 tpy

[1] Limits obtained from agency permitting documents when not available in RBLC.
[2] USEPA's interim Tier 4 limits under 40 CFR 1039.104(g), Table 1
[3] USEPA's final Tier 4 limits under 40 CFR 1039.101(b), Table 1

Table D-4: Summary of Recent PSD BACT Determinations for Emergency Fire Pump Engines at Simple-Cycle Generating Plants

Facility	Location	Permit Date	Engine Size	PM	GHGs
LBWL--ERICKSON STATION	Eaton County , MI	12/21/2018	315 hp	0.12 lb/hr	20 tpy
NRG Canal 3	Sandwich, MA	08/0/4/17	135 hp	Subpart III	N/A
West Medway Generating	Medway, MA	12/19/16/	197 hp	Subpart III	N/A
Duke Suwannee River Power	Live Oak, FL	04/28/15	160 hp	Subpart III	N/A
Carlsbad Energy Center	Carlsbad, CA	04/17/15	327 hp	Subpart III	128 tpy
Guadalupe Generating Station	Guadalupe County, TX	12/02/14	1.92 MMBtu/hr	Subpart III	15.7 tpy
Tenaska Roan's Prairie Partners	Grimes, TX	09/22/14	575 hp	Subpart III	33 tpy
Invenergy Ector County Energy Center	Ector, TX	08/01/14	250 hp	Subpart III	5 tpy
Perryman Generating	Harford County, MD	07/01/14	350 hp	Subpart III	N/A
Indeck Wharton Energy Center	Wharton, TX	05/12/14	175 hp	Subpart III	5.34 tpy
FP&L Lauderdale	Broward, FL	04/22/14	300 hp	Subpart III	N/A
Black Hills - Cheyenne Prairie Generating Station	Laramie, WY	08/28/12	327 hp	Subpart III	51 tpy

Table D-5a Capital Cost Estimate for Diesel Particulate Filter

Fire System Pump #1

Cost Category	One Fire Water Pump	Factor	Basis for Cost and Factor
Capacity, kWm	**117**		
DIRECT COSTS:			
PURCHASED EQUIPMENT			
(a) Primary and Auxiliary Equipment (PE)	$23,577	NRG Middletown vendor estimate of $60,000 for a 555 kWm engine x (117/555)^0.6	
(b) Instrumentation & Controls	$0	Incldued in vendor estiamte	EPA, Sect 3.2, Chap. 2, Table 2.9
(c) Sales Tax	$1,179	5% of PE	EPA, Sect 3.2, Chap. 2, Table 2.9
(d) Freight	$1,179	5% of PE	EPA, Sect 3.2, Chap. 2, Table 2.9
TOTAL PURCHASED EQUIPMENT Cost (PEC):	$25,935		
DIRECT INSTALLATION			
(a) Foundation	$2,075	PEC X 0.08	EPA, Sect 3.2, Chap. 2, Table 2.9
(b) Erection and handling	$3,631	PEC X 0.14	EPA, Sect 3.2, Chap. 2, Table 2.9
(c) Electrical	$1,037	PEC X 0..04	EPA, Sect 3.2, Chap. 2, Table 2.9
(d) Piping	$519	PEC X 0.02	EPA, Sect 3.2, Chap. 2, Table 2.9
(f) Insulation	$259	PEC X 0.01	EPA, Sect 3.2, Chap. 2, Table 2.9
(g) Painting	$259	PEC X 0.01	EPA, Sect 3.2, Chap. 2, Table 2.9
TOTAL DIRECT INSTALLATION (DI):	**$7,780**		
TOTAL DIRECT COST (DC):	**$33,715**		
INDIRECT COSTS			
INDIRECT INSTALLATION			
(a) Engineering & Project Management	$2,593	PEC X 0.10	EPA, Sect 3.2, Chap. 2, Table 2.9
(b) Construction & Field Expenses	$1,297	PEC X 0.05	EPA, Sect 3.2, Chap. 2, Table 2.9
(c) Contractor Fees	$2,593	PEC X 0..10	EPA, Sect 3.2, Chap. 2, Table 2.9
(d) Startup Expenses	$519	PEC X 0.08	EPA, Sect 3.2, Chap. 2, Table 2.9
(g) Performance Tests	$259	PEC X 0.01	EPA, Sect 3.2, Chap. 2, Table 2.9
(h) Contingencies	$778	PEC X 0.02	EPA, Sect 3.2, Chap. 2, Table 2.9
TOTAL INDIRECT COST:	**$8,040**		
TOTAL INSTALLED COST (TIC)	**$41,800**		

EPA Air Pollution Control Cost Manual, Sixth Edition, EPA/452/B-002-001. January 2002.

Table D-5b Annual Cost Estimate for Diesel Particulate Filter

Fire System Pump #1

Cost Category	One Fire Water Pump	Factor	Basis for Cost and Factor
Capital Cost			
Total Installed Cost	$ 41,800	See Table D-5a	
Source Capacity, kWm	117		
Diesel engine, bhp	157		
Annual Operation, hours	500		
Emissions before Control, g/kWh	0.30	NSPS Subpart IIII	
Emissions before Control, ton/yr	0.019	Calculated	
Control Efficiency, %	90.0%		
Emissions after Control, g/kWh	0.030	Calculated	
Emissions after Control, ton/yr	0.0019	Calculated	
Emission Reduction, ton/yr	0.0174	Calculated	
Annual Costs, $/yr			
Catalyst Replacement Cost	$ -	Assumed not to happen in 10 years	
Operation and Maintenance Labor	$ 600	1 hr/month ar $50/hr	
Maintenance Materials	$ 836	2 % of TCC	
Taxes, Insurance, and Administration	$ 1,672	4% of total installed cost based on EPA cost	EPA, Sect 1, Chap2, Para 2.5.5.8
Capital Recovery	$ 5,951	7.0%, 10 years, 0.1424 x (TCI-catalyst) [c]	
Total Annual Cost	$ 9,059	Calculated	
Emission Reduction, ton/yr	0.01741	Calculated	
Cost Effectiveness, $ per ton emission reduction	$ 520,000	Calculated	

EPA Air Pollution Control Cost Manual, Sixth Edition, EPA/452/B-002-001. January 2002.

Table D-6a Capital Cost Estimate for Diesel Particulate Filter

Fire System Pump #2

Cost Category	One Fire Water Pump	Factor	Basis for Cost and Factor
Capacity, kWm	**177**		
DIRECT COSTS:			
PURCHASED EQUIPMENT			
(a) Primary and Auxiliary Equipment (PE)	$30,225	NRG Middletown vendor estimate of $60,000 for a 555 kWm engine x (117/555)^0.6	
(b) Instrumentation & Controls	$0	Incldued in vendor estiamte	EPA, Sect 3.2, Chap. 2, Table 2.9
(c) Sales Tax	$1,511	5% of PE	EPA, Sect 3.2, Chap. 2, Table 2.9
(d) Freight	$1,511	5% of PE	EPA, Sect 3.2, Chap. 2, Table 2.9
TOTAL PURCHASED EQUIPMENT Cost (PEC):	$33,247		
DIRECT INSTALLATION			
(a) Foundation	$2,660	PEC X 0.08	EPA, Sect 3.2, Chap. 2, Table 2.9
(b) Erection and handling	$4,655	PEC X 0.14	EPA, Sect 3.2, Chap. 2, Table 2.9
(c) Electrical	$1,330	PEC X 0..04	EPA, Sect 3.2, Chap. 2, Table 2.9
(d) Piping	$665	PEC X 0.02	EPA, Sect 3.2, Chap. 2, Table 2.9
(f) Insulation	$332	PEC X 0.01	EPA, Sect 3.2, Chap. 2, Table 2.9
(g) Painting	$332	PEC X 0.01	EPA, Sect 3.2, Chap. 2, Table 2.9
TOTAL DIRECT INSTALLATION (DI):	**$9,974**		
TOTAL DIRECT COST (DC):	**$43,221**		
INDIRECT COSTS			
INDIRECT INSTALLATION			
(a) Engineering & Project Management	$3,325	PEC X 0.10	EPA, Sect 3.2, Chap. 2, Table 2.9
(b) Construction & Field Expenses	$1,662	PEC X 0.05	EPA, Sect 3.2, Chap. 2, Table 2.9
(c) Contractor Fees	$3,325	PEC X 0..10	EPA, Sect 3.2, Chap. 2, Table 2.9
(d) Startup Expenses	$665	PEC X 0.08	EPA, Sect 3.2, Chap. 2, Table 2.9
(g) Performance Tests	$332	PEC X 0.01	EPA, Sect 3.2, Chap. 2, Table 2.9
(h) Contingencies	$997	PEC X 0.02	EPA, Sect 3.2, Chap. 2, Table 2.9
TOTAL INDIRECT COST:	**$10,307**		
TOTAL INSTALLED COST (TIC)	**$53,500**		

EPA Air Pollution Control Cost Manual, Sixth Edition, EPA/452/B-002-001. January 2002.

Table D-6b Annual Cost Estimate for Diesel Particulate Filter

Fire System Pump #2

Cost Category	One Fire Water Pump	Factor	Basis for Cost and Factor
Capital Cost			
Total Installed Cost	$ 53,500	See Table D-6a	
Source Capacity, kWm	177		
Diesel engine, bhp	237		
Annual Operation, hours	500		
Emissions before Control, g/kWm	0.20	NSPS Subpart IIII	
Emissions before Control, ton/yr	0.020	Calculated	
Control Efficiency, %	90.0%		
Emissions after Control, g/kWm	0.020	Calculated	
Emissions after Control, ton/yr	0.0020	Calculated	
Emission Reduction, ton/yr	0.0176	Calculated	
Annual Costs, $/yr			
Catalyst Replacement Cost	$ -	Assumed not to happen in 10 years	
Operation and Maintenance Labor	$ 600	1 hr/month ar $50/hr	
Maintenance Materials	$ 1,070	2 % of TCC	
Taxes, Insurance, and Administration	$ 2,140	4% of total installed cost based on EPA cost	EPA, Sect 1, Chap2, Para 2.5.5.8
Capital Recovery	$ 7,617	7.0%, 10 years, 0.1424 x (TCI-catalyst) (c)	
Total Annual Cost	$ 11,427	Calculated	
Emission Reduction, ton/yr	0.01756	Calculated	
Cost Effectiveness, $ per ton emission reduction	$ 651,000	Calculated	

EPA Air Pollution Control Cost Manual, Sixth Edition, EPA/452/B-002-001. January 2002.

Appendix E

Modeling Information

Emissions

Case	Fuel	Load	Evap	Pollutant Emissions (g/sec)			
				CO	NOx	PM	SO2
C7	Nat. Gas	Base	Evap On	3.92	4.60	3.19	0.70
C8	Nat. Gas	Base	Evap On	3.64	4.27	3.14	0.65
C9	Nat. Gas	Base	Evap Off	3.36	3.95	3.12	0.60
C10	Nat. Gas	75% Load	Evap Off	2.62	3.08	2.23	0.47
C11	Nat. Gas	50% Load	Evap Off	2.00	2.35	2.09	0.36
C12	Nat. Gas	40% Load	Evap Off	1.74	2.05	2.04	0.31
C25	Nat. Gas	Base	Evap On	3.86	4.53	3.05	0.69
C26	Nat. Gas	Base	Evap Off	3.79	4.45	3.04	0.68
C27	Nat. Gas	75% Load	Evap Off	2.92	3.43	2.23	0.52
C28	Nat. Gas	50% Load	Evap Off	2.21	2.60	2.10	0.40
C29	Nat. Gas	30% Load	Evap Off	1.63	1.91	2.00	0.29
C30	Nat. Gas	Base	Evap Off	3.83	4.49	3.04	0.69
C31	Nat. Gas	75% Load	Evap Off	2.95	3.46	2.23	0.53
C32	Nat. Gas	50% Load	Evap Off	2.23	2.62	2.10	0.40
C33	Nat. Gas	30% Load	Evap Off	1.64	1.93	2.00	0.29
C42	Nat. Gas	Base	Evap Off	3.88	4.56	2.82	0.70
C43	Nat. Gas	75% Load	Evap Off	3.02	3.54	2.20	0.54
C44	Nat. Gas	50% Load	Evap Off	2.30	2.70	2.08	0.41
C45	Nat. Gas	39.38% Load	Evap Off	1.99	2.33	2.03	0.36
C52	ULSD	Base	Evap On	5.85	9.62	8.96	0.76
C53	ULSD	Base	Evap On	5.52	9.07	8.92	0.72
C54	ULSD	Base	Evap Off	5.13	8.43	8.90	0.67
C55	ULSD	75% Load	Evap Off	4.01	6.59	8.44	0.52
C56	ULSD	50% Load	Evap Off	3.15	5.18	8.62	0.41
C67	ULSD	Base	Evap On	5.90	9.70	8.91	0.77
C68	ULSD	Base	Evap Off	5.82	9.57	8.90	0.76
C69	ULSD	75% Load	Evap Off	4.52	7.43	8.56	0.59
C70	ULSD	50% Load	Evap Off	3.52	5.79	8.66	0.46
C71	ULSD	Base	Evap Off	5.89	9.68	8.90	0.76
C72	ULSD	75% Load	Evap Off	4.58	7.52	8.58	0.59
C73	ULSD	50% Load	Evap Off	3.57	5.86	8.66	0.46
C80	ULSD	Base	Evap Off	5.95	9.78	8.81	0.77
C81	ULSD	75% Load	Evap Off	4.72	7.76	8.64	0.61
C82	ULSD	63% Load	Evap Off	4.22	6.93	8.62	0.55

X/Q Results (1 g/sec)

Case	Fuel	Load	Evap	Maximum Modeled Concentration per Averaging Period ($\mu g/m^3$)			
				1hr	3hr	8hr	24hr
C7	Nat. Gas	Base	Evap On	0.126	0.113	0.080	0.037
C8	Nat. Gas	Base	Evap On	0.130	0.118	0.084	0.039
C9	Nat. Gas	Base	Evap Off	0.134	0.124	0.089	0.041
C10	Nat. Gas	75% Load	Evap Off	0.158	0.153	0.114	0.053
C11	Nat. Gas	50% Load	Evap Off	0.185	0.177	0.137	0.064
C12	Nat. Gas	40% Load	Evap Off	0.245	0.189	0.149	0.070
C25	Nat. Gas	Base	Evap On	0.129	0.117	0.083	0.039
C26	Nat. Gas	Base	Evap Off	0.130	0.118	0.084	0.039
C27	Nat. Gas	75% Load	Evap Off	0.154	0.148	0.110	0.051
C28	Nat. Gas	50% Load	Evap Off	0.181	0.174	0.134	0.063
C29	Nat. Gas	30% Load	Evap Off	0.264	0.201	0.162	0.076
C30	Nat. Gas	Base	Evap Off	0.130	0.118	0.084	0.039
C31	Nat. Gas	75% Load	Evap Off	0.154	0.148	0.110	0.051
C32	Nat. Gas	50% Load	Evap Off	0.180	0.174	0.134	0.062
C33	Nat. Gas	30% Load	Evap Off	0.264	0.201	0.162	0.076
C42	Nat. Gas	Base	Evap Off	0.134	0.124	0.089	0.041
C43	Nat. Gas	75% Load	Evap Off	0.158	0.153	0.114	0.053
C44	Nat. Gas	50% Load	Evap Off	0.185	0.177	0.137	0.064
C45	Nat. Gas	39.38% Load	Evap Off	0.246	0.190	0.150	0.070
C52	ULSD	Base	Evap On	0.131	0.119	0.085	0.039
C53	ULSD	Base	Evap On	0.134	0.123	0.088	0.041
C54	ULSD	Base	Evap Off	0.138	0.129	0.093	0.043
C55	ULSD	75% Load	Evap Off	0.162	0.157	0.117	0.055
C56	ULSD	50% Load	Evap Off	0.178	0.172	0.132	0.062
C67	ULSD	Base	Evap On	0.133	0.122	0.087	0.040
C68	ULSD	Base	Evap Off	0.134	0.123	0.088	0.041
C69	ULSD	75% Load	Evap Off	0.156	0.150	0.111	0.052
C70	ULSD	50% Load	Evap Off	0.174	0.167	0.127	0.059
C71	ULSD	Base	Evap Off	0.133	0.122	0.088	0.041
C72	ULSD	75% Load	Evap Off	0.155	0.149	0.111	0.052
C73	ULSD	50% Load	Evap Off	0.174	0.167	0.127	0.059
C80	ULSD	Base	Evap Off	0.137	0.128	0.092	0.043
C81	ULSD	75% Load	Evap Off	0.156	0.150	0.112	0.052
C82	ULSD	63% Load	Evap Off	0.165	0.159	0.120	0.056

Pollutant Specific Results

Case	Fuel	Load	Evap	Maximum Modeled Concentration per Averaging Period ($\mu g/m^3$)							
				NOx	SO2	SO2	SO2	CO	CO	PM2.5	PM10
				1hr	1hr	3hr	24hr	1hr	8hr	24hr	24hr
C7	Nat. Gas	Base	Evap On	0.58	0.09	0.08	0.03	0.49	0.31	0.12	0.12
C8	Nat. Gas	Base	Evap On	0.55	0.08	0.08	0.03	0.47	0.31	0.12	0.12
C9	Nat. Gas	Base	Evap Off	0.53	0.08	0.07	0.02	0.45	0.30	0.13	0.13
C10	Nat. Gas	75% Load	Evap Off	0.49	0.07	0.07	0.02	0.42	0.30	0.12	0.12
C11	Nat. Gas	50% Load	Evap Off	0.43	0.07	0.06	0.02	0.37	0.27	0.13	0.13
C12	Nat. Gas	40% Load	Evap Off	0.50	0.08	0.06	0.02	0.43	0.26	0.14	0.14
C25	Nat. Gas	Base	Evap On	0.59	0.09	0.08	0.03	0.50	0.32	0.12	0.12
C26	Nat. Gas	Base	Evap Off	0.58	0.09	0.08	0.03	0.49	0.32	0.12	0.12
C27	Nat. Gas	75% Load	Evap Off	0.53	0.08	0.08	0.03	0.45	0.32	0.11	0.11
C28	Nat. Gas	50% Load	Evap Off	0.47	0.07	0.07	0.02	0.40	0.30	0.13	0.13
C29	Nat. Gas	30% Load	Evap Off	0.50	0.08	0.06	0.02	0.43	0.26	0.15	0.15
C30	Nat. Gas	Base	Evap Off	0.58	0.09	0.08	0.03	0.50	0.32	0.12	0.12
C31	Nat. Gas	75% Load	Evap Off	0.53	0.08	0.08	0.03	0.45	0.32	0.11	0.11
C32	Nat. Gas	50% Load	Evap Off	0.47	0.07	0.07	0.02	0.40	0.30	0.13	0.13
C33	Nat. Gas	30% Load	Evap Off	0.51	0.08	0.06	0.02	0.43	0.27	0.15	0.15
C42	Nat. Gas	Base	Evap Off	0.61	0.09	0.09	0.03	0.52	0.35	0.12	0.12
C43	Nat. Gas	75% Load	Evap Off	0.56	0.09	0.08	0.03	0.48	0.34	0.12	0.12
C44	Nat. Gas	50% Load	Evap Off	0.50	0.08	0.07	0.03	0.43	0.32	0.13	0.13
C45	Nat. Gas	9.38% Loa	Evap Off	0.57	0.09	0.07	0.02	0.49	0.30	0.14	0.14
C52	ULSD	Base	Evap On	1.26	0.10	0.09	0.03	0.77	0.50	0.35	0.35
C53	ULSD	Base	Evap On	1.21	0.10	0.09	0.03	0.74	0.49	0.37	0.37
C54	ULSD	Base	Evap Off	1.16	0.09	0.09	0.03	0.71	0.48	0.38	0.38
C55	ULSD	75% Load	Evap Off	1.07	0.08	0.08	0.03	0.65	0.47	0.46	0.46
C56	ULSD	50% Load	Evap Off	0.92	0.07	0.07	0.03	0.56	0.42	0.530	0.530
C67	ULSD	Base	Evap On	1.29	0.10	0.09	0.03	0.78	0.51	0.36	0.36
C68	ULSD	Base	Evap Off	1.28	0.10	0.09	0.03	0.78	0.51	0.36	0.36
C69	ULSD	75% Load	Evap Off	1.16	0.09	0.09	0.03	0.70	0.50	0.44	0.44
C70	ULSD	50% Load	Evap Off	1.01	0.08	0.08	0.03	0.61	0.45	0.51	0.51
C71	ULSD	Base	Evap Off	1.29	0.10	0.09	0.03	0.78	0.52	0.36	0.36
C72	ULSD	75% Load	Evap Off	1.17	0.09	0.09	0.03	0.71	0.51	0.44	0.44
C73	ULSD	50% Load	Evap Off	1.02	0.08	0.08	0.03	0.62	0.45	0.51	0.51
C80	ULSD	Base	Evap Off	1.339	0.106	0.099	0.033	0.815	0.549	0.38	0.38
C81	ULSD	75% Load	Evap Off	1.21	0.10	0.09	0.03	0.74	0.53	0.45	0.45
C82	ULSD	63% Load	Evap Off	1.15	0.09	0.09	0.03	0.6981	0.5053	0.48	0.48

Emissions

Case	Fuel	Load	Evap	Pollutant Emissions (g/sec)																			
				1, 3 Butadine	Acetaldehyde	Acrolein	Benzene	Ethylbenzene	Formaldehyde	PAHs	Propylene Oxide	Toluene	Xylenes	Naphthalene	Arsenic	Beryllium	Cadmium	Chromium	Lead	Manganese	Nickel	Mercury	Selenium
C7	Nat. Gas	Base	Evap On	1.29E-04	1.20E-02	1.92E-03	3.60E-03	9.59E-03	2.13E-01	6.59E-04	8.69E-03	3.90E-02	1.92E-02	-	-	-	-	-	-	-	-	-	-
C8	Nat. Gas	Base	Evap On	1.20E-04	1.11E-02	1.78E-03	3.34E-03	8.91E-03	1.98E-01	6.13E-04	8.08E-03	3.62E-02	1.78E-02	-	-	-	-	-	-	-	-	-	-
C9	Nat. Gas	Base	Evap Off	1.11E-04	1.03E-02	1.65E-03	3.09E-03	8.23E-03	1.83E-01	5.66E-04	7.46E-03	3.34E-02	1.65E-02	-	-	-	-	-	-	-	-	-	-
C10	Nat. Gas	75% Load	Evap Off	8.62E-05	8.02E-03	1.28E-03	2.41E-03	6.42E-03	1.42E-01	4.41E-04	5.82E-03	2.61E-02	1.28E-02	-	-	-	-	-	-	-	-	-	-
C11	Nat. Gas	50% Load	Evap Off	6.58E-05	6.12E-03	9.80E-04	1.84E-03	4.90E-03	1.09E-01	3.37E-04	4.44E-03	1.99E-02	9.80E-03	-	-	-	-	-	-	-	-	-	-
C12	Nat. Gas	40% Load	Evap Off	5.74E-05	5.34E-03	8.54E-04	1.60E-03	4.27E-03	9.48E-02	2.94E-04	3.87E-03	1.74E-02	8.54E-03	-	-	-	-	-	-	-	-	-	-
C25	Nat. Gas	Base	Evap On	1.27E-04	1.18E-02	1.89E-03	3.54E-03	9.45E-03	2.10E-01	6.50E-04	8.56E-03	3.84E-02	1.89E-02	-	-	-	-	-	-	-	-	-	-
C26	Nat. Gas	Base	Evap Off	1.25E-04	1.16E-02	1.86E-03	3.48E-03	9.28E-03	2.06E-01	6.38E-04	8.41E-03	3.77E-02	1.86E-02	-	-	-	-	-	-	-	-	-	-
C27	Nat. Gas	75% Load	Evap Off	9.61E-05	8.94E-03	1.43E-03	2.68E-03	7.15E-03	1.59E-01	4.92E-04	6.48E-03	2.91E-02	1.43E-02	-	-	-	-	-	-	-	-	-	-
C28	Nat. Gas	50% Load	Evap Off	7.28E-05	6.78E-03	1.08E-03	2.03E-03	5.42E-03	1.20E-01	3.73E-04	4.91E-03	2.20E-02	1.08E-02	-	-	-	-	-	-	-	-	-	-
C29	Nat. Gas	30% Load	Evap Off	5.36E-05	4.99E-03	7.98E-04	1.50E-03	3.99E-03	8.86E-02	2.74E-04	3.62E-03	1.62E-02	7.98E-03	-	-	-	-	-	-	-	-	-	-
C30	Nat. Gas	Base	Evap Off	1.26E-04	1.17E-02	1.87E-03	3.52E-03	9.37E-03	2.08E-01	6.44E-04	8.50E-03	3.81E-02	1.87E-02	-	-	-	-	-	-	-	-	-	-
C31	Nat. Gas	75% Load	Evap Off	9.70E-05	9.03E-03	1.44E-03	2.71E-03	7.22E-03	1.60E-01	4.96E-04	6.54E-03	2.93E-02	1.44E-02	-	-	-	-	-	-	-	-	-	-
C32	Nat. Gas	50% Load	Evap Off	7.35E-05	6.83E-03	1.09E-03	2.05E-03	5.47E-03	1.21E-01	3.76E-04	4.95E-03	2.22E-02	1.09E-02	-	-	-	-	-	-	-	-	-	-
C33	Nat. Gas	30% Load	Evap Off	5.40E-05	5.03E-03	8.04E-04	1.51E-03	4.02E-03	8.92E-02	2.76E-04	3.64E-03	1.63E-02	8.04E-03	-	-	-	-	-	-	-	-	-	-
C42	Nat. Gas	Base	Evap Off	1.28E-04	1.19E-02	1.90E-03	3.56E-03	9.51E-03	2.11E-01	6.54E-04	8.61E-03	3.86E-02	1.90E-02	-	-	-	-	-	-	-	-	-	-
C43	Nat. Gas	75% Load	Evap Off	9.93E-05	9.24E-03	1.48E-03	2.77E-03	7.39E-03	1.64E-01	5.08E-04	6.70E-03	3.00E-02	1.48E-02	-	-	-	-	-	-	-	-	-	-
C44	Nat. Gas	50% Load	Evap Off	7.57E-05	7.04E-03	1.13E-03	2.11E-03	5.63E-03	1.25E-01	3.87E-04	5.10E-03	2.29E-02	1.13E-02	-	-	-	-	-	-	-	-	-	-
C45	Nat. Gas	39.38% Load	Evap Off	6.53E-05	6.08E-03	9.72E-04	1.82E-03	4.86E-03	1.08E-01	3.34E-04	4.40E-03	1.97E-02	9.72E-03	-	-	-	-	-	-	-	-	-	-
C52	ULSD	Base	Evap On	4.76E-03	-	-	1.63E-02	-	8.32E-02	1.19E-02	-	-	-	8.26E-02	4.32E-02	1.22E-03	1.81E-02	4.32E-02	5.50E-02	3.11E+00	1.81E-02	4.72E-03	9.83E-02
C53	ULSD	Base	Evap On	4.48E-03	-	-	1.54E-02	-	7.85E-02	1.12E-02	-	-	-	7.79E-02	4.08E-02	1.15E-03	1.71E-02	4.08E-02	5.19E-02	2.93E+00	1.71E-02	4.45E-03	9.27E-02
C54	ULSD	Base	Evap Off	4.17E-03	-	-	1.43E-02	-	7.30E-02	1.04E-02	-	-	-	7.24E-02	3.79E-02	1.07E-03	1.59E-02	3.79E-02	4.83E-02	2.72E+00	1.59E-02	4.14E-03	8.62E-02
C55	ULSD	75% Load	Evap Off	3.26E-03	-	-	1.12E-02	-	5.70E-02	8.14E-03	-	-	-	5.66E-02	2.96E-02	8.35E-04	1.24E-02	2.96E-02	3.77E-02	2.13E+00	1.24E-02	3.23E-03	6.73E-02
C56	ULSD	50% Load	Evap Off	2.56E-03	-	-	8.80E-03	-	4.48E-02	6.40E-03	-	-	-	4.45E-02	2.33E-02	6.56E-04	9.74E-03	2.33E-02	2.96E-02	1.67E+00	9.74E-03	2.54E-03	5.29E-02
C67	ULSD	Base	Evap On	4.79E-03	-	-	1.65E-02	-	8.39E-02	1.20E-02	-	-	-	8.32E-02	4.36E-02	1.23E-03	1.82E-02	4.36E-02	5.55E-02	3.13E+00	1.82E-02	4.75E-03	9.90E-02
C68	ULSD	Base	Evap Off	4.73E-03	-	-	1.63E-02	-	8.27E-02	1.18E-02	-	-	-	8.21E-02	4.30E-02	1.21E-03	1.80E-02	4.30E-02	5.47E-02	3.09E+00	1.80E-02	4.69E-03	9.77E-02
C69	ULSD	75% Load	Evap Off	3.67E-03	-	-	1.26E-02	-	6.43E-02	9.18E-03	-	-	-	6.38E-02	3.34E-02	9.41E-04	1.40E-02	3.34E-02	4.25E-02	2.40E+00	1.40E-02	3.64E-03	7.59E-02
C70	ULSD	50% Load	Evap Off	2.86E-03	-	-	9.84E-03	-	5.01E-02	7.16E-03	-	-	-	4.97E-02	2.60E-02	7.34E-04	1.09E-02	2.60E-02	3.31E-02	1.87E+00	1.09E-02	2.84E-03	5.92E-02
C71	ULSD	Base	Evap Off	4.78E-03	-	-	1.64E-02	-	8.37E-02	1.20E-02	-	-	-	8.30E-02	4.35E-02	1.23E-03	1.82E-02	4.35E-02	5.54E-02	3.12E+00	1.82E-02	4.75E-03	9.89E-02
C72	ULSD	75% Load	Evap Off	3.72E-03	-	-	1.28E-02	-	6.50E-02	9.29E-03	-	-	-	6.45E-02	3.38E-02	9.52E-04	1.41E-02	3.38E-02	4.30E-02	2.43E+00	1.41E-02	3.69E-03	7.68E-02
C73	ULSD	50% Load	Evap Off	2.90E-03	-	-	9.96E-03	-	5.07E-02	7.24E-03	-	-	-	5.03E-02	2.63E-02	7.42E-04	1.10E-02	2.63E-02	3.35E-02	1.89E+00	1.10E-02	2.87E-03	5.99E-02
C80	ULSD	Base	Evap Off	4.83E-03	-	-	1.66E-02	-	8.46E-02	1.21E-02	-	-	-	8.39E-02	4.40E-02	1.24E-03	1.84E-02	4.40E-02	5.59E-02	3.16E+00	1.84E-02	4.80E-03	9.99E-02
C81	ULSD	75% Load	Evap Off	3.84E-03	-	-	1.32E-02	-	6.71E-02	9.59E-03	-	-	-	6.66E-02	3.49E-02	9.83E-04	1.46E-02	3.49E-02	4.44E-02	2.51E+00	1.46E-02	3.81E-03	7.93E-02
C82	ULSD	63% Load	Evap Off	3.43E-03	-	-	1.18E-02	-	6.00E-02	8.57E-03	-	-	-	5.95E-02	3.12E-02	8.78E-04	1.30E-02	3.12E-02	3.97E-02	2.24E+00	1.30E-02	3.40E-03	7.08E-02

Pollutant Specific Results

				Maximum Modeled Concentration per Averaging Period ($\mu g/m^3$)																			
Case	Fuel	Load	Evap	1, 3 Butadine	Acetaldehyde	Acrolein	Benzene	Ethylbenzene	Formaldehyde	PAHs	Propylene Oxide	Toluene	Xylenes	Naphthalene	Arsenic	Beryllium	Cadmium	Chromium	Lead	Manganese	Nickel	Mercury	Selenium
				1hr	1hr	1hr	1hr	1hr	1hr	1hr	1hr	1hr	1hr	1hr	1hr	1hr	1hr	1hr	1hr	1hr	1hr	1hr	1hr
C7	Nat. Gas	Base	Evap On	1.63E-05	1.51E-03	2.42E-04	4.54E-04	1.21E-03	2.69E-02	8.32E-05	1.10E-03	4.92E-03	2.42E-03	-	-	-	-	-	-	-	-	-	-
C8	Nat. Gas	Base	Evap On	1.55E-05	1.44E-03	2.31E-04	4.33E-04	1.16E-03	2.56E-02	7.94E-05	1.05E-03	4.69E-03	2.31E-03	-	-	-	-	-	-	-	-	-	-
C9	Nat. Gas	Base	Evap Off	1.49E-05	1.38E-03	2.21E-04	4.15E-04	1.11E-03	2.45E-02	7.60E-05	1.00E-03	4.49E-03	2.21E-03	-	-	-	-	-	-	-	-	-	-
C10	Nat. Gas	75% Load	Evap Off	1.37E-05	1.27E-03	2.03E-04	3.81E-04	1.02E-03	2.26E-02	6.99E-05	9.21E-04	4.13E-03	2.03E-03	-	-	-	-	-	-	-	-	-	-
C11	Nat. Gas	50% Load	Evap Off	1.22E-05	1.13E-03	1.81E-04	3.40E-04	9.06E-04	2.01E-02	6.23E-05	8.21E-04	3.68E-03	1.81E-03	-	-	-	-	-	-	-	-	-	-
C12	Nat. Gas	40% Load	Evap Off	1.41E-05	1.31E-03	2.09E-04	3.93E-04	1.05E-03	2.32E-02	7.20E-05	9.49E-04	4.25E-03	2.09E-03	-	-	-	-	-	-	-	-	-	-
C25	Nat. Gas	Base	Evap On	1.64E-05	1.53E-03	2.44E-04	4.58E-04	1.22E-03	2.71E-02	8.40E-05	1.11E-03	4.96E-03	2.44E-03	-	-	-	-	-	-	-	-	-	-
C26	Nat. Gas	Base	Evap Off	1.62E-05	1.51E-03	2.41E-04	4.53E-04	1.21E-03	2.68E-02	8.30E-05	1.09E-03	4.90E-03	2.41E-03	-	-	-	-	-	-	-	-	-	-
C27	Nat. Gas	75% Load	Evap Off	1.48E-05	1.38E-03	2.20E-04	4.13E-04	1.10E-03	2.44E-02	7.57E-05	9.98E-04	4.48E-03	2.20E-03	-	-	-	-	-	-	-	-	-	-
C28	Nat. Gas	50% Load	Evap Off	1.32E-05	1.23E-03	1.96E-04	3.68E-04	9.82E-04	2.18E-02	6.75E-05	8.90E-04	3.99E-03	1.96E-03	-	-	-	-	-	-	-	-	-	-
C29	Nat. Gas	30% Load	Evap Off	1.41E-05	1.32E-03	2.11E-04	3.95E-04	1.05E-03	2.34E-02	7.24E-05	9.54E-04	4.28E-03	2.11E-03	-	-	-	-	-	-	-	-	-	-
C30	Nat. Gas	Base	Evap Off	1.64E-05	1.52E-03	2.43E-04	4.57E-04	1.22E-03	2.70E-02	8.37E-05	1.10E-03	4.95E-03	2.43E-03	-	-	-	-	-	-	-	-	-	-
C31	Nat. Gas	75% Load	Evap Off	1.49E-05	1.39E-03	2.22E-04	4.17E-04	1.11E-03	2.47E-02	7.64E-05	1.01E-03	4.52E-03	2.22E-03	-	-	-	-	-	-	-	-	-	-
C32	Nat. Gas	50% Load	Evap Off	1.33E-05	1.23E-03	1.97E-04	3.70E-04	9.86E-04	2.19E-02	6.78E-05	8.94E-04	4.01E-03	1.97E-03	-	-	-	-	-	-	-	-	-	-
C33	Nat. Gas	30% Load	Evap Off	1.42E-05	1.33E-03	2.12E-04	3.98E-04	1.06E-03	2.35E-02	7.29E-05	9.61E-04	4.31E-03	2.12E-03	-	-	-	-	-	-	-	-	-	-
C42	Nat. Gas	Base	Evap Off	1.72E-05	1.60E-03	2.55E-04	4.79E-04	1.28E-03	2.83E-02	8.78E-05	1.16E-03	5.19E-03	2.55E-03	-	-	-	-	-	-	-	-	-	-
C43	Nat. Gas	75% Load	Evap Off	1.57E-05	1.46E-03	2.34E-04	4.39E-04	1.17E-03	2.60E-02	8.05E-05	1.06E-03	4.75E-03	2.34E-03	-	-	-	-	-	-	-	-	-	-
C44	Nat. Gas	50% Load	Evap Off	1.40E-05	1.30E-03	2.08E-04	3.90E-04	1.04E-03	2.31E-02	7.16E-05	9.43E-04	4.23E-03	2.08E-03	-	-	-	-	-	-	-	-	-	-
C45	Nat. Gas	39.38% Load	Evap Off	1.61E-05	1.50E-03	2.39E-04	4.49E-04	1.20E-03	2.66E-02	8.23E-05	1.08E-03	4.86E-03	2.39E-03	-	-	-	-	-	-	-	-	-	-
C52	ULSD	Base	Evap On	6.21E-04	-	-	2.14E-03	-	1.09E-02	1.55E-03	-	-	-	1.08E-02	5.65E-03	1.59E-04	2.36E-03	5.65E-03	7.19E-03	4.06E-01	2.36E-03	6.17E-04	1.28E-02
C53	ULSD	Base	Evap On	6.00E-04	-	-	2.06E-03	-	1.05E-02	1.50E-03	-	-	-	1.04E-02	5.45E-03	1.54E-04	2.28E-03	5.45E-03	6.94E-03	3.92E-01	2.28E-03	5.95E-04	1.24E-02
C54	ULSD	Base	Evap Off	5.74E-04	-	-	1.97E-03	-	1.01E-02	1.44E-03	-	-	-	9.97E-03	5.22E-03	1.47E-04	2.18E-03	5.22E-03	6.65E-03	3.75E-01	2.18E-03	5.70E-04	1.19E-02
C55	ULSD	75% Load	Evap Off	5.29E-04	-	-	1.82E-03	-	9.26E-03	1.32E-03	-	-	-	9.19E-03	4.81E-03	1.36E-04	2.01E-03	4.81E-03	6.13E-03	3.46E-01	2.01E-03	5.25E-04	1.09E-02
C56	ULSD	50% Load	Evap Off	4.57E-04	-	-	1.57E-03	-	8.00E-03	1.14E-03	-	-	-	7.93E-03	4.15E-03	1.17E-04	1.74E-03	4.15E-03	5.29E-03	2.98E-01	1.74E-03	4.53E-04	9.44E-03
C67	ULSD	Base	Evap On	6.36E-04	-	-	2.19E-03	-	1.11E-02	1.59E-03	-	-	-	1.10E-02	5.78E-03	1.63E-04	2.42E-03	5.78E-03	7.36E-03	4.15E-01	2.42E-03	6.31E-04	1.31E-02
C68	ULSD	Base	Evap Off	6.31E-04	-	-	2.17E-03	-	1.11E-02	1.58E-03	-	-	-	1.10E-02	5.74E-03	1.62E-04	2.40E-03	5.74E-03	7.31E-03	4.12E-01	2.40E-03	6.26E-04	1.31E-02
C69	ULSD	75% Load	Evap Off	5.72E-04	-	-	1.96E-03	-	1.00E-02	1.43E-03	-	-	-	9.92E-03	5.20E-03	1.46E-04	2.17E-03	5.20E-03	6.62E-03	3.73E-01	2.17E-03	5.67E-04	1.18E-02
C70	ULSD	50% Load	Evap Off	4.98E-04	-	-	1.71E-03	-	8.72E-03	1.25E-03	-	-	-	8.65E-03	4.53E-03	1.28E-04	1.90E-03	4.53E-03	5.77E-03	3.26E-01	1.90E-03	4.94E-04	1.03E-02
C71	ULSD	Base	Evap Off	6.37E-04	-	-	2.19E-03	-	1.11E-02	1.59E-03	-	-	-	1.11E-02	5.79E-03	1.63E-04	2.42E-03	5.79E-03	7.37E-03	4.16E-01	2.42E-03	6.32E-04	1.32E-02
C72	ULSD	75% Load	Evap Off	5.77E-04	-	-	1.98E-03	-	1.01E-02	1.44E-03	-	-	-	1.00E-02	5.25E-03	1.48E-04	2.19E-03	5.25E-03	6.68E-03	3.77E-01	2.19E-03	5.72E-04	1.19E-02
C73	ULSD	50% Load	Evap Off	5.03E-04	-	-	1.73E-03	-	8.81E-03	1.26E-03	-	-	-	8.74E-03	4.58E-03	1.29E-04	1.91E-03	4.58E-03	5.82E-03	3.29E-01	1.91E-03	4.99E-04	1.04E-02
C80	ULSD	Base	Evap Off	6.62E-04	-	-	2.27E-03	-	1.16E-02	1.65E-03	-	-	-	1.15E-02	6.02E-03	1.70E-04	2.52E-03	6.02E-03	7.66E-03	4.32E-01	2.52E-03	6.57E-04	1.37E-02
C81	ULSD	75% Load	Evap Off	5.99E-04	-	-	2.06E-03	-	1.05E-02	1.50E-03	-	-	-	1.04E-02	5.44E-03	1.53E-04	2.28E-03	5.44E-03	6.93E-03	3.91E-01	2.28E-03	5.94E-04	1.24E-02
C82	ULSD	63% Load	Evap Off	5.67E-04	-	-	1.95E-03	-	9.92E-03	1.42E-03	-	-	-	9.84E-03	5.16E-03	1.45E-04	2.16E-03	5.16E-03	6.56E-03	3.70E-01	2.16E-03	5.63E-04	1.17E-02

Maximum 1-Hour X/Q Concentration ($\mu g/m^3$ per g/sec)								
C42_SS	C42_SU	C80_SS	C80_SU	PW1	PW2	EGEN	FPUMP1	FPUMP2
0.13	0.32	0.14	0.33	33.51	35.04	619.03	889.76	873.54

	Short-Term Source Emissions (lb/hr)									1-Hour Source Impacts ($\mu g/m^3$)										
Air Toxic Pollutant	C42_SS	C42_SU	C80_SS	C80_SU	PW1	PW2	EGEN	FPUMP1	FPUMP2	C42_SS	C42_SU	C80_SS	C80_SU	PW1	PW2	EGEN	FPUMP1	FPUMP2	Total Impacts	SGC ($\mu g/m^3$)
1, 3 Butadine	1.01E-03	7.00E-04	3.84E-02	2.72E-02	4.08E-03	4.08E-03	0.00E+00	4.59E-05	6.97E-05	1.72E-05	2.83E-05	6.63E-04	1.13E-03	1.72E-02	1.80E-02	0.00E+00	5.15E-03	7.67E-03	4.98E-02	N/A
Acetaldehyde	9.43E-02	6.51E-02	0.00E+00	0.00E+00	1.02E-02	1.02E-02	1.26E-04	9.01E-04	1.37E-03	1.60E-03	2.63E-03	0.00E+00	0.00E+00	4.31E-02	4.50E-02	9.82E-03	1.01E-01	1.50E-01	3.54E-01	470
Acrolein	1.51E-02	1.04E-02	0.00E+00	0.00E+00	1.63E-03	1.63E-03	3.94E-05	1.09E-04	1.65E-04	2.56E-04	4.21E-04	0.00E+00	0.00E+00	6.89E-03	7.20E-03	3.07E-03	1.22E-02	1.81E-02	4.82E-02	2.5
Arsenic	0.00E+00	0.00E+00	4.40E-02	1.87E-02	2.81E-03	2.81E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.59E-04	7.80E-04	1.18E-02	1.24E-02	0.00E+00	0.00E+00	0.00E+00	2.58E-02	N/A
Benzene	2.83E-02	1.95E-02	1.32E-01	9.33E-02	1.40E-02	1.40E-02	3.88E-03	1.10E-03	1.66E-03	4.80E-04	7.90E-04	2.28E-03	3.90E-03	5.92E-02	6.19E-02	3.02E-01	1.23E-01	1.83E-01	7.35E-01	1300
Beryllium	0.00E+00	0.00E+00	1.24E-03	5.26E-04	7.91E-05	7.91E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.14E-05	2.20E-05	3.34E-04	3.49E-04	0.00E+00	0.00E+00	0.00E+00	7.26E-04	N/A
Cadmium	0.00E+00	0.00E+00	1.84E-02	8.15E-03	1.17E-03	1.17E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.18E-04	3.40E-04	4.95E-03	5.18E-03	0.00E+00	0.00E+00	0.00E+00	1.08E-02	N/A
Chromium	0.00E+00	0.00E+00	4.40E-02	1.87E-02	2.81E-03	2.81E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.59E-04	7.80E-04	1.18E-02	1.24E-02	0.00E+00	0.00E+00	0.00E+00	2.58E-02	N/A
Ethylbenzene	7.54E-02	5.21E-02	0.00E+00	0.00E+00	8.16E-03	8.16E-03	0.00E+00	0.00E+00	0.00E+00	1.28E-03	2.11E-03	0.00E+00	0.00E+00	3.44E-02	3.60E-02	0.00E+00	0.00E+00	0.00E+00	7.39E-02	N/A
Formaldehyde	1.67E+00	1.16E+00	6.71E-01	4.75E-01	1.81E-01	1.81E-01	3.94E-04	1.39E-03	2.10E-03	2.84E-02	4.67E-02	1.16E-02	1.99E-02	7.64E-01	7.99E-01	3.07E-02	1.55E-01	2.31E-01	2.06E+00	30
Lead	0.00E+00	0.00E+00	5.59E-02	2.38E-02	3.57E-03	3.57E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.66E-04	9.93E-04	1.51E-02	1.58E-02	0.00E+00	0.00E+00	0.00E+00	3.28E-02	N/A
Manganese	0.00E+00	0.00E+00	3.16E+00	1.34E+00	2.01E-01	2.01E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.45E-02	5.60E-02	8.50E-01	8.89E-01	0.00E+00	0.00E+00	0.00E+00	1.85E+00	N/A
Mercury	0.00E+00	0.00E+00	4.80E-03	2.04E-03	3.06E-04	3.06E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.28E-05	8.51E-05	1.29E-03	1.35E-03	0.00E+00	0.00E+00	0.00E+00	2.81E-03	6.00E-01
Naphthalene	0.00E+00	0.00E+00	8.39E-02	5.94E-02	8.93E-03	8.93E-03	6.49E-04	9.96E-05	1.51E-04	0.00E+00	0.00E+00	1.45E-03	2.48E-03	3.77E-02	3.94E-02	5.06E-02	1.12E-02	1.66E-02	1.59E-01	7900
Nickel	0.00E+00	0.00E+00	1.84E-02	7.81E-03	1.17E-03	1.17E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.18E-04	3.26E-04	4.95E-03	5.18E-03	0.00E+00	0.00E+00	0.00E+00	1.08E-02	2.00E-01
PAH	5.19E-03	3.58E-03	9.59E-02	6.79E-02	1.02E-02	1.02E-02	1.06E-03	1.97E-04	2.99E-04	8.80E-05	1.45E-04	1.66E-03	2.84E-03	4.31E-02	4.50E-02	8.26E-02	2.21E-02	3.30E-02	2.30E-01	N/A
Propylene Oxide	6.84E-02	4.72E-02	0.00E+00	0.00E+00	7.40E-03	7.40E-03	0.00E+00	0.00E+00	0.00E+00	1.16E-03	1.91E-03	0.00E+00	0.00E+00	3.12E-02	3.26E-02	0.00E+00	0.00E+00	0.00E+00	6.69E-02	3100
Selenium	0.00E+00	0.00E+00	9.99E-02	4.24E-02	6.38E-03	6.38E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.73E-03	1.77E-03	2.69E-02	2.81E-02	0.00E+00	0.00E+00	0.00E+00	5.86E-02	N/A
Toluene	3.06E-01	2.12E-01	0.00E+00	0.00E+00	3.32E-02	3.32E-02	1.40E-03	4.80E-04	7.29E-04	5.20E-03	8.55E-03	0.00E+00	0.00E+00	1.40E-01	1.46E-01	1.09E-01	5.39E-02	8.02E-02	5.44E-01	37000
Xylenes	1.51E-01	1.04E-01	0.00E+00	0.00E+00	1.63E-02	1.63E-02	9.64E-04	3.35E-04	5.08E-04	2.56E-03	4.21E-03	0.00E+00	0.00E+00	6.89E-02	7.20E-02	7.52E-02	3.75E-02	5.59E-02	3.16E-01	22000

Maximum Annual X/Q Concentration ($\mu g/m^3$ per g/sec)								
C25_SS	C25_SUSD	C80_SS	C80_SUSD	PW1	PW2	EGEN	FPUMP1	FPUMP2
0.00338	0.0053	0.00353	0.00587	0.11122	0.11056	30.9	41.6	59.9

	Long-Term Source Emissions (tpy)									Annual Source Impacts ($\mu g/m^3$)										
Air Toxic Pollutant	C25_SS	C25_SUSD	C80_SS	C80_SU	PW1	PW2	EGEN	FPUMP1	FPUMP2	C25_SS	C25_SUSD	C80_SS	C80_SUSD	PW1	PW2	EGEN	FPUMP1	FPUMP2	Total Impacts	AGC ($\mu g/m^3$)
1, 3 Butadine	9.57E-04	2.41E-09	3.64E-02	9.27E-08	2.45E-05	2.45E-05	0.00E+00	1.15E-05	1.74E-05	9.31E-08	3.67E-13	3.70E-06	1.57E-11	7.83E-08	7.79E-08	0.00E+00	1.37E-05	3.00E-05	4.77E-05	3.30E-02
Acetaldehyde	8.91E-02	2.24E-07	0.00E+00	0.00E+00	6.12E-05	6.12E-05	3.15E-05	2.25E-04	3.42E-04	8.66E-06	3.42E-11	0.00E+00	0.00E+00	1.96E-07	1.95E-07	2.80E-05	2.69E-04	5.89E-04	8.95E-04	4.50E-01
Acrolein	1.43E-02	3.59E-08	0.00E+00	0.00E+00	9.79E-06	9.79E-06	9.84E-06	2.72E-05	4.12E-05	1.39E-06	5.47E-12	0.00E+00	0.00E+00	3.13E-08	3.11E-08	8.75E-06	3.25E-05	7.11E-05	1.14E-04	3.50E-01
Arsenic	0.00E+00	0.00E+00	4.18E-02	7.17E-08	1.68E-05	1.68E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.24E-06	1.21E-11	5.38E-08	5.35E-08	0.00E+00	0.00E+00	0.00E+00	4.35E-06	2.30E-04
Benzene	2.67E-02	6.72E-08	1.25E-01	3.19E-07	8.42E-05	8.42E-05	9.69E-04	2.74E-04	4.16E-04	2.60E-06	1.03E-11	1.27E-05	5.38E-11	2.69E-07	2.68E-07	8.62E-04	3.28E-04	7.17E-04	1.92E-03	1.30E-01
Beryllium	0.00E+00	0.00E+00	1.18E-03	2.02E-09	4.74E-07	4.74E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.20E-07	3.41E-13	1.52E-09	1.51E-09	0.00E+00	0.00E+00	0.00E+00	1.23E-07	4.20E-04
Cadmium	0.00E+00	0.00E+00	1.75E-02	3.13E-08	7.04E-06	7.04E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.77E-06	5.28E-12	2.25E-08	2.24E-08	0.00E+00	0.00E+00	0.00E+00	1.82E-06	2.40E-04
Chromium	0.00E+00	0.00E+00	4.18E-02	7.17E-08	1.68E-05	1.68E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.24E-06	1.21E-11	5.38E-08	5.35E-08	0.00E+00	0.00E+00	0.00E+00	4.35E-06	45
Ethylbenzene	7.13E-02	1.79E-07	0.00E+00	0.00E+00	4.90E-05	4.90E-05	0.00E+00	0.00E+00	0.00E+00	6.93E-06	2.73E-11	0.00E+00	0.00E+00	1.57E-07	1.56E-07	0.00E+00	0.00E+00	0.00E+00	7.24E-06	1000
Formaldehyde	1.58E+00	3.98E-06	6.38E-01	1.62E-06	1.09E-03	1.09E-03	9.85E-05	3.46E-04	5.26E-04	1.54E-04	6.07E-10	6.48E-05	2.74E-10	3.48E-06	3.45E-06	8.76E-05	4.14E-04	9.06E-04	1.63E-03	6.00E-02
Lead	0.00E+00	0.00E+00	5.31E-02	9.13E-08	2.14E-05	2.14E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.40E-06	1.54E-11	6.85E-08	6.81E-08	0.00E+00	0.00E+00	0.00E+00	5.53E-06	3.80E-02
Manganese	0.00E+00	0.00E+00	3.00E+00	5.15E-06	1.21E-03	1.21E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.05E-04	8.70E-10	3.87E-06	3.84E-06	0.00E+00	0.00E+00	0.00E+00	3.12E-04	5.00E-02
Mercury	0.00E+00	0.00E+00	4.56E-03	7.82E-09	1.84E-06	1.84E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.63E-07	1.32E-12	5.87E-09	5.84E-09	0.00E+00	0.00E+00	0.00E+00	4.74E-07	3.00E-01
Naphthalene	0.00E+00	0.00E+00	7.97E-02	2.03E-07	5.36E-05	5.36E-05	1.62E-04	2.49E-05	3.78E-05	0.00E+00	0.00E+00	8.10E-06	3.43E-11	1.71E-07	1.70E-07	1.44E-04	2.98E-05	6.51E-05	2.48E-04	3
Nickel	0.00E+00	0.00E+00	1.75E-02	3.00E-08	7.04E-06	7.04E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.77E-06	5.06E-12	2.25E-08	2.24E-08	0.00E+00	0.00E+00	0.00E+00	1.82E-06	4.20E-03
PAH	4.90E-03	1.23E-08	9.11E-02	2.32E-07	6.12E-05	6.12E-05	2.65E-04	4.93E-05	7.48E-05	4.76E-07	1.88E-12	9.25E-06	3.92E-11	1.96E-07	1.95E-07	2.35E-04	5.90E-05	1.29E-04	4.34E-04	2.00E-02
Propylene Oxide	6.46E-02	1.63E-07	0.00E+00	0.00E+00	4.44E-05	4.44E-05	0.00E+00	0.00E+00	0.00E+00	6.28E-06	2.48E-11	0.00E+00	0.00E+00	1.42E-07	1.41E-07	0.00E+00	0.00E+00	0.00E+00	6.56E-06	2.70E-01
Selenium	0.00E+00	0.00E+00	9.49E-02	1.63E-07	3.83E-05	3.83E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.64E-06	2.75E-11	1.22E-07	1.22E-07	0.00E+00	0.00E+00	0.00E+00	9.88E-06	20
Toluene	2.89E-01	7.28E-07	0.00E+00	0.00E+00	1.99E-04	1.99E-04	3.51E-04	1.20E-04	1.82E-04	2.81E-05	1.11E-10	0.00E+00	0.00E+00	6.36E-07	6.33E-07	3.12E-04	1.44E-04	3.14E-04	7.99E-04	5000
Xylenes	1.43E-01	3.59E-07	0.00E+00	0.00E+00	9.79E-05	9.79E-05	2.41E-04	8.37E-05	1.27E-04	1.39E-05	5.47E-11	0.00E+00	0.00E+00	3.13E-07	3.11E-07	2.14E-04	1.00E-04	2.19E-04	5.48E-04	100

Maximum 1-Hour X/Q Concentration (μg/m³ per g/sec)								
C42_SS	C42_SU	C80_SS	C80_SU	PW1	PW2	EGEN	FPUMP1	FPUMP2
0.12	0.21	0.12	0.21	2.62	2.74	51.95	38.90	34.29

	Short-Term Source Emissions (lb/hr)									1-Hour Source Impacts (μg/m³)										
Air Toxic Pollutant	C42_SS	C42_SU	C80_SS	C80_SU	PW1	PW2	EGEN	FPUMP1	FPUMP2	C42_SS	C42_SU	C80_SS	C80_SU	PW1	PW2	EGEN	FPUMP1	FPUMP2	Total Impacts	SGC (μg/m³)
1, 3 Butadine	1.01E-03	7.00E-04	3.84E-02	2.72E-02	4.08E-03	4.08E-03	1.95E-04	4.59E-05	6.97E-05	1.55E-05	1.83E-05	5.95E-04	7.27E-04	1.34E-03	1.41E-03	1.28E-03	2.25E-04	3.01E-04	5.88E-03	N/A
Acetaldehyde	9.43E-02	6.51E-02	0.00E+00	0.00E+00	1.02E-02	1.02E-02	3.83E-03	1.14E-03	1.72E-03	1.44E-03	1.70E-03	0.00E+00	0.00E+00	3.36E-03	3.52E-03	2.51E-02	5.57E-03	7.44E-03	4.81E-02	470
Acrolein	1.51E-02	1.04E-02	0.00E+00	0.00E+00	1.63E-03	1.63E-03	4.62E-04	1.09E-04	1.65E-04	2.31E-04	2.72E-04	0.00E+00	0.00E+00	5.38E-04	5.64E-04	3.02E-03	5.33E-04	7.12E-04	5.87E-03	2.5
Arsenic	0.00E+00	0.00E+00	4.40E-02	1.87E-02	2.81E-03	2.81E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.81E-04	5.00E-04	9.24E-04	9.69E-04	0.00E+00	0.00E+00	0.00E+00	3.07E-03	N/A
Benzene	2.83E-02	1.95E-02	1.32E-01	9.33E-02	1.40E-02	1.40E-02	4.66E-03	1.10E-03	1.66E-03	4.32E-04	5.10E-04	2.04E-03	2.50E-03	4.62E-03	4.85E-03	3.05E-02	5.37E-03	7.18E-03	5.71E-02	1300
Beryllium	0.00E+00	0.00E+00	1.24E-03	5.26E-04	7.91E-05	7.91E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.92E-05	1.41E-05	2.60E-05	2.73E-05	0.00E+00	0.00E+00	0.00E+00	8.67E-05	N/A
Cadmium	0.00E+00	0.00E+00	1.84E-02	8.15E-03	1.17E-03	1.17E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.85E-04	2.18E-04	3.87E-04	4.05E-04	0.00E+00	0.00E+00	0.00E+00	1.29E-03	N/A
Chromium	0.00E+00	0.00E+00	4.40E-02	1.87E-02	2.81E-03	2.81E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.81E-04	5.00E-04	9.24E-04	9.69E-04	0.00E+00	0.00E+00	0.00E+00	3.07E-03	N/A
Ethylbenzene	7.54E-02	5.21E-02	0.00E+00	0.00E+00	8.16E-03	8.16E-03	0.00E+00	0.00E+00	0.00E+00	1.15E-03	1.36E-03	0.00E+00	0.00E+00	2.69E-03	2.82E-03	0.00E+00	0.00E+00	0.00E+00	8.02E-03	N/A
Formaldehyde	1.67E+00	1.16E+00	6.71E-01	4.75E-01	1.81E-01	1.81E-01	5.89E-03	1.39E-03	2.10E-03	2.56E-02	3.02E-02	1.04E-02	1.27E-02	5.97E-02	6.26E-02	3.86E-02	6.79E-03	9.08E-03	2.32E-01	30
Lead	0.00E+00	0.00E+00	5.59E-02	2.38E-02	3.57E-03	3.57E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.67E-04	6.36E-04	1.18E-03	1.23E-03	0.00E+00	0.00E+00	0.00E+00	3.91E-03	N/A
Manganese	0.00E+00	0.00E+00	3.16E+00	1.34E+00	2.01E-01	2.01E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.89E-02	3.59E-02	6.64E-02	6.96E-02	0.00E+00	0.00E+00	0.00E+00	2.21E-01	N/A
Mercury	0.00E+00	0.00E+00	4.80E-03	2.04E-03	3.06E-04	3.06E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.43E-05	5.45E-05	1.01E-04	1.06E-04	0.00E+00	0.00E+00	0.00E+00	3.35E-04	6.00E-01
Naphthalene	0.00E+00	0.00E+00	8.39E-02	5.94E-02	8.93E-03	8.93E-03	4.24E-04	9.96E-05	1.51E-04	0.00E+00	0.00E+00	1.30E-03	1.59E-03	2.94E-03	3.08E-03	2.77E-03	4.88E-04	6.53E-04	1.28E-02	7900
Nickel	0.00E+00	0.00E+00	1.84E-02	7.81E-03	1.17E-03	1.17E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.85E-04	2.09E-04	3.87E-04	4.05E-04	0.00E+00	0.00E+00	0.00E+00	1.29E-03	2.00E-01
PAH	5.19E-03	3.58E-03	9.59E-02	6.79E-02	1.02E-02	1.02E-02	8.39E-04	9.77E-05	1.48E-04	7.92E-05	9.35E-05	1.49E-03	1.82E-03	3.36E-03	3.52E-03	5.49E-03	4.79E-04	6.41E-04	1.68E-02	N/A
Propylene Oxide	6.84E-02	4.72E-02	0.00E+00	0.00E+00	7.40E-03	7.40E-03	0.00E+00	0.00E+00	0.00E+00	1.04E-03	1.23E-03	0.00E+00	0.00E+00	2.44E-03	2.56E-03	0.00E+00	0.00E+00	0.00E+00	7.27E-03	3100
Selenium	0.00E+00	0.00E+00	9.99E-02	4.24E-02	6.38E-03	6.38E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.55E-03	1.14E-03	2.10E-03	2.20E-03	0.00E+00	0.00E+00	0.00E+00	6.99E-03	N/A
Toluene	3.06E-01	2.12E-01	0.00E+00	0.00E+00	3.32E-02	3.32E-02	2.04E-03	4.80E-04	7.29E-04	4.68E-03	5.53E-03	0.00E+00	0.00E+00	1.09E-02	1.15E-02	1.34E-02	2.35E-03	3.15E-03	5.15E-02	37000
Xylenes	1.51E-01	1.04E-01	0.00E+00	0.00E+00	1.63E-02	1.63E-02	1.42E-03	3.03E-04	4.60E-04	2.31E-03	2.72E-03	0.00E+00	0.00E+00	5.38E-03	5.64E-03	9.32E-03	1.49E-03	1.99E-03	2.88E-02	22000

Revised November 2020

Maximum Annual X/Q Concentration ($\mu g/m^3$ per g/sec)								
C25_SS	C25_SUSD	C80_SS	C80_SUSD	PW1	PW2	EGEN	FPUMP1	FPUMP2
0.00355	0.00556	0.00367	0.00597	0.06422	0.06341	1.6	2.1	2.0

	Long-Term Source Emissions (tpy)									Annual Source Impacts ($\mu g/m^3$)										
Air Toxic Pollutant	C25_SS	C25_SUSD	C80_SS	C80_SU	PW1	PW2	EGEN	FPUMP1	FPUMP2	C25_SS	C25_SUSD	C80_SS	C80_SUSD	PW1	PW2	EGEN	FPUMP1	FPUMP2	Total Impacts	AGC ($\mu g/m^3$)
1, 3 Butadine	9.57E-04	2.41E-09	3.64E-02	9.27E-08	2.45E-05	2.45E-05	4.88E-05	1.15E-05	1.74E-05	9.78E-08	3.85E-13	3.85E-06	1.59E-11	4.52E-08	4.47E-08	2.28E-06	7.05E-07	1.01E-06	8.03E-06	3.30E-02
Acetaldehyde	8.91E-02	2.24E-07	0.00E+00	0.00E+00	6.12E-05	6.12E-05	9.58E-04	2.84E-04	4.31E-04	9.10E-06	3.58E-11	0.00E+00	0.00E+00	1.13E-07	1.12E-07	4.48E-05	1.74E-05	2.49E-05	9.65E-05	4.50E-01
Acrolein	1.43E-02	3.59E-08	0.00E+00	0.00E+00	9.79E-06	9.79E-06	1.16E-04	2.72E-05	4.12E-05	1.46E-06	5.74E-12	0.00E+00	0.00E+00	1.81E-08	1.79E-08	5.40E-06	1.67E-06	2.39E-06	1.09E-05	3.50E-01
Arsenic	0.00E+00	0.00E+00	4.18E-02	7.17E-08	1.68E-05	1.68E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.41E-06	1.23E-11	3.11E-08	3.07E-08	0.00E+00	0.00E+00	0.00E+00	4.47E-06	2.30E-04
Benzene	2.67E-02	6.72E-08	1.25E-01	3.19E-07	8.42E-05	8.42E-05	1.17E-03	2.74E-04	4.16E-04	2.73E-06	1.08E-11	1.32E-05	5.48E-11	1.55E-07	1.53E-07	5.45E-05	1.68E-05	2.41E-05	1.12E-04	1.30E-01
Beryllium	0.00E+00	0.00E+00	1.18E-03	2.02E-09	4.74E-07	4.74E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.24E-07	3.47E-13	8.76E-10	8.65E-10	0.00E+00	0.00E+00	0.00E+00	1.26E-07	4.20E-04
Cadmium	0.00E+00	0.00E+00	1.75E-02	3.13E-08	7.04E-06	7.04E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.84E-06	5.37E-12	1.30E-08	1.28E-08	0.00E+00	0.00E+00	0.00E+00	1.87E-06	2.40E-04
Chromium	0.00E+00	0.00E+00	4.18E-02	7.17E-08	1.68E-05	1.68E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.41E-06	1.23E-11	3.11E-08	3.07E-08	0.00E+00	0.00E+00	0.00E+00	4.47E-06	45
Ethylbenzene	7.13E-02	1.79E-07	0.00E+00	0.00E+00	4.90E-05	4.90E-05	0.00E+00	0.00E+00	0.00E+00	7.28E-06	2.87E-11	0.00E+00	0.00E+00	9.04E-08	8.93E-08	0.00E+00	0.00E+00	0.00E+00	7.46E-06	1000
Formaldehyde	1.58E+00	3.98E-06	6.38E-01	1.62E-06	1.09E-03	1.09E-03	1.47E-03	3.46E-04	5.26E-04	1.61E-04	6.36E-10	6.73E-05	2.79E-10	2.01E-06	1.98E-06	6.89E-05	2.13E-05	3.04E-05	3.53E-04	6.00E-02
Lead	0.00E+00	0.00E+00	5.31E-02	9.13E-08	2.14E-05	2.14E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.61E-06	1.57E-11	3.96E-08	3.91E-08	0.00E+00	0.00E+00	0.00E+00	5.69E-06	3.80E-02
Manganese	0.00E+00	0.00E+00	3.00E+00	5.15E-06	1.21E-03	1.21E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.17E-04	8.84E-10	2.23E-06	2.20E-06	0.00E+00	0.00E+00	0.00E+00	3.21E-04	5.00E-02
Mercury	0.00E+00	0.00E+00	4.56E-03	7.82E-09	1.84E-06	1.84E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.81E-07	1.34E-12	3.39E-09	3.35E-09	0.00E+00	0.00E+00	0.00E+00	4.88E-07	3.00E-01
Naphthalene	0.00E+00	0.00E+00	7.97E-02	2.03E-07	5.36E-05	5.36E-05	1.06E-04	2.49E-05	3.78E-05	0.00E+00	0.00E+00	8.42E-06	3.48E-11	9.89E-08	9.77E-08	4.95E-06	1.53E-06	2.19E-06	1.73E-05	3
Nickel	0.00E+00	0.00E+00	1.75E-02	3.00E-08	7.04E-06	7.04E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.84E-06	5.15E-12	1.30E-08	1.28E-08	0.00E+00	0.00E+00	0.00E+00	1.87E-06	4.20E-03
PAH	4.90E-03	1.23E-08	9.11E-02	2.32E-07	6.12E-05	6.12E-05	2.10E-04	2.44E-05	3.71E-05	5.00E-07	1.97E-12	9.62E-06	3.98E-11	1.13E-07	1.12E-07	9.81E-06	1.50E-06	2.15E-06	2.38E-05	2.00E-02
Propylene Oxide	6.46E-02	1.63E-07	0.00E+00	0.00E+00	4.44E-05	4.44E-05	0.00E+00	0.00E+00	0.00E+00	6.59E-06	2.60E-11	0.00E+00	0.00E+00	8.20E-08	8.09E-08	0.00E+00	0.00E+00	0.00E+00	6.76E-06	2.70E-01
Selenium	0.00E+00	0.00E+00	9.49E-02	1.63E-07	3.83E-05	3.83E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E-05	2.80E-11	7.07E-08	6.98E-08	0.00E+00	0.00E+00	0.00E+00	1.02E-05	20
Toluene	2.89E-01	7.28E-07	0.00E+00	0.00E+00	1.99E-04	1.99E-04	5.11E-04	1.20E-04	1.82E-04	2.96E-05	1.17E-10	0.00E+00	0.00E+00	3.67E-07	3.63E-07	2.39E-05	7.38E-06	1.05E-05	7.21E-05	5000
Xylenes	1.43E-01	3.59E-07	0.00E+00	0.00E+00	9.79E-05	9.79E-05	3.56E-04	7.58E-05	1.15E-04	1.46E-05	5.74E-11	0.00E+00	0.00E+00	1.81E-07	1.79E-07	1.66E-05	4.65E-06	6.65E-06	4.29E-05	100

Appendix F

Navigant/Guidehouse Study: GHG Impacts of Astoria Replacement Project and Supplement

Appendix F.1

Navigant/Guidehouse April 2020 GHG Report

NAVIGANT
A Guidehouse Company

GHG Impacts of Astoria Replacement Project

Prepared for Astoria Gas Turbine Power LLC

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DISCLAIMER

This report was prepared by Navigant Consulting, Inc., n/k/a Guidehouse Inc. ("Navigant") for Astoria Gas Turbine Power LLC ("Astoria"). The work presented in this report represents Navigant's best professional judgment based on the information available at the time this report was prepared. Navigant is not responsible for the reader's use of, or reliance upon, the report, nor any decisions based on the report. NAVIGANT MAKES NO REPRESENTATIONS OR WARRANTIES, EXPRESSED OR IMPLIED. Readers of the report are advised that they assume all liabilities incurred by them, or third parties, as a result of their reliance on the report, or the data, information, findings and opinions contained in the report.

EXECUTIVE SUMMARY

Astoria Gas Turbine Power LLC ("Astoria") is proposing to modify its previously permitted 1,040 MW project to replace twenty four nearly 50-year-old Pratt & Whitney ("P&W") combustion turbines and seven recently retired Westinghouse combustion turbines at Astoria with a new, state-of-the-art, H-class simple cycle combustion turbine generator ("CTG") (the "Astoria Replacement Project" or the "Project"). The need for the Replacement Project is driven by the anticipated impacts of climate change policies and regulatory frameworks that are pushing modernization and decarbonization of the New York Independent System Operator ("NYISO") and especially the New York City generation fleet.

The purpose of this report is to describe the greenhouse gas ("GHG") emissions impacts of the Astoria Replacement Project and to describe how the Project is consistent with the New York State Climate Leadership and Community Protection Act ("CLCPA"). Based on the GHG reductions that will result from the Project, it is consistent with the attainment of the Article 75 GHG emission limits.

The CLCPA requires the New York State Department of Environmental Conservation ("NYSDEC") to implement regulations, pursuant to the CLCPA and Article 75 of the New York Environmental Conservation Law ("ECL"), that reduce GHG emissions 40% (from 1990 levels) by 2030 and 85% by 2050. It also requires the New York Public Service Commission ("NYPSC") to implement a program to meet the targets of 70% of electricity to be sourced from renewable generation by 2030 and obtain a statewide zero-emissions electrical system by 2040. While these regulations and programs have not yet been developed by NYSDEC or NYPSC, Section 7(2) of the CLCPA requires all state agencies to consider whether the decision to issue permit(s) is inconsistent with or will interfere with the attainment of the GHG emission limits established in ECL Article 75.

This analysis evaluates the impact of the Project on statewide GHG emissions based on full compliance with the CLCPA's targets and limits.[1] The results show that the Project is consistent with the CLCPA and provides significant GHG reduction, while minimizing costs and maximizing benefits to New York via the following mechanisms:

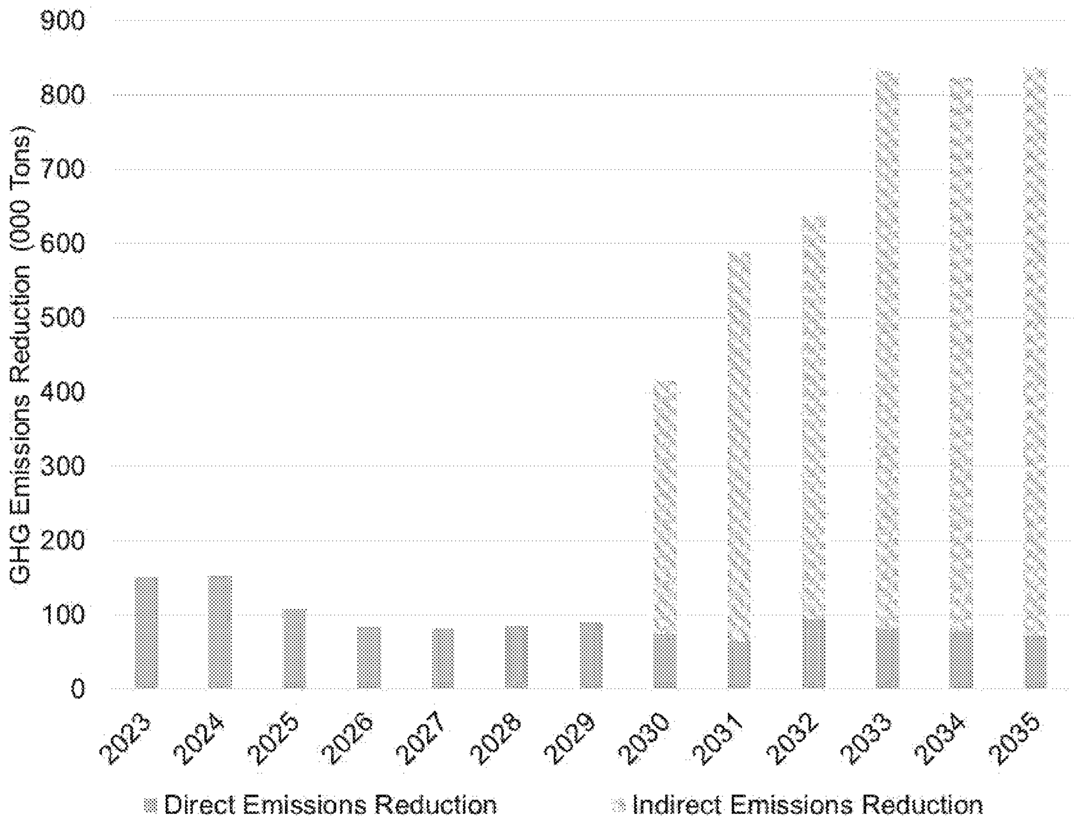
- Direct reduction through displacement of older, less efficient generation in New York City. This also includes reduction in GHG emissions due to extraction and transmission of fossil fuels imported into the state.
- Indirect reduction by providing required quick start and fast ramping capacity to maintain reliability in New York City. This allows New York to avoid the installation of very large amounts of marginal capacity from energy storage, the cost savings of which can be applied to accelerate procurement of additional renewable resources including significant amounts of offshore wind.

Figure 1 shows the annual direct and indirect GHG emissions reductions due to the Project based on (i) comparing emissions from the Project with emissions from replacement generation that would be required without the Project and (ii) additional renewable generation that can be added to the system from cost savings attributable to the Project. The cumulative reductions through 2035 is nearly 5 million tons of GHG. Post-2035, emissions are still reduced by the Project, but the quantity depends on how the system

[1] All figures and charts are from Navigant analysis, unless otherwise noted.

ultimately reaches full decarbonization and whether (and when) the Project starts to generate electricity using hydrogen fuel.

Figure 1. GHG Benefits of Astoria Replacement Project



Source: Navigant Analysis

Building the Project is also consistent with the long-term targets and goals of the CLCPA, which require 70% of electricity statewide to be sourced from renewables by 2030, shifting to zero-carbon emission generation by 2040, as the Project's CTG technology is already capable of being converted to use zero-emission hydrogen as fuel once it becomes commercially available in sufficient quantities via a commercial delivery system such as the existing natural gas pipeline system.

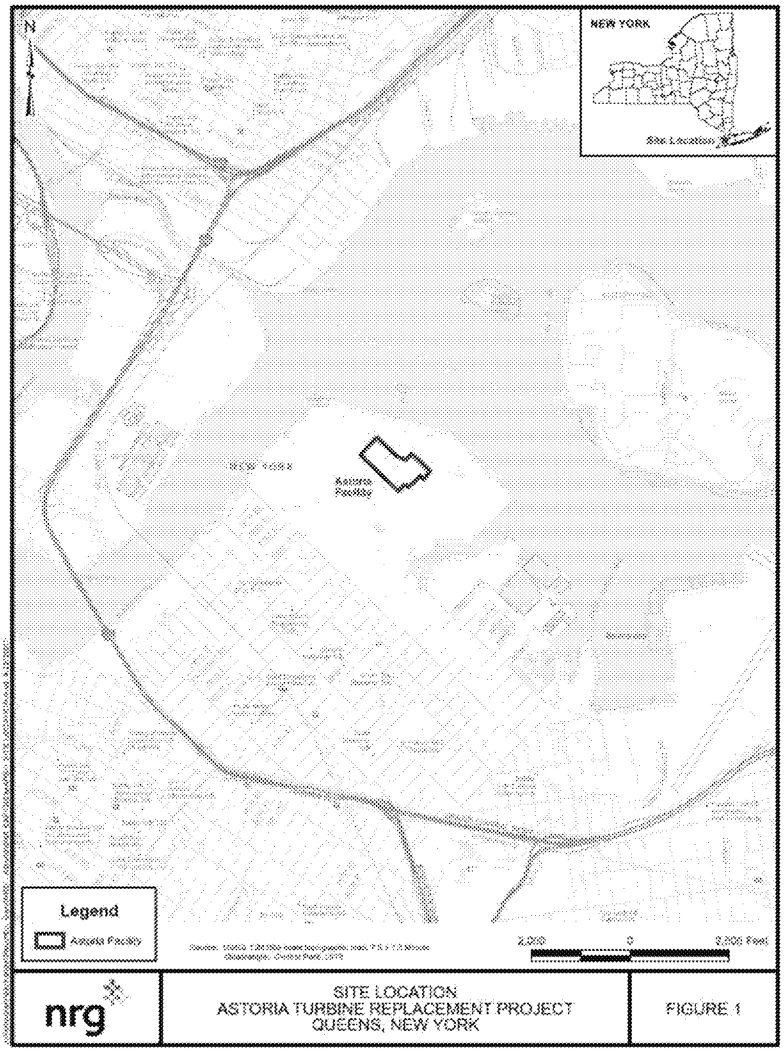
1. ASTORIA REPLACEMENT PROJECT

The Astoria Replacement Project is being developed at the approximately 15.7-acre Astoria Gas Turbine Facility ("the Facility") located at 31-01 20th Ave., Astoria, Queens County, New York, situated within a large 600+ acre complex (referred to as the "Astoria ConEd Complex") shown in Figure 2. The Facility currently consists of 31 older, dual-fuel (natural gas and ultra-low sulfur kerosene) combustion turbine generators including 24 Pratt & Whitney turbines and seven retired Westinghouse turbines, with a combined nameplate rating of 646 megawatts ("MW").

Astoria is proposing to modify its previously approved project. The Project will replace the 50-year-old P&W and previously retired Westinghouse CTGs at the Facility with a new, state-of-the-art, dual fuel, simple cycle combustion turbine generator unit. The proposed replacement unit (General Electric 7HA.03 or equivalent) has a nominal generator output of approximately 437 MW.

All of the existing units, with the exception of one P&W Twin Pac (consisting of two combustion turbines and a single generator), will be permanently shut down once the new unit has completed its shakedown period. The two remaining P&W turbines will remain operational to make the site black-start capable until replaced by an approximately 24 MWe battery energy storage system ("BESS").

Figure 2. Astoria Replacement Project Site Location



Source: AECOM

2. ENVIRONMENTAL REGULATIONS DRIVING CHANGE IN NEW YORK

Environmental regulations and policies are causing significant shifts in the resource and generation mix in New York. The GHG emission reduction requirements and renewable targets and decarbonization goals laid out in the CLCPA provide the framework for procuring future electric generators and drive the long-term shift away from thermal resources towards zero-emission energy capacity. Stricter regulations lowering plant emissions are also important drivers behind retirements across New York State, including within New York City.

Section 2 describes the two main environmental policies that focus on reducing GHG emissions and decarbonizing New York state and New York City's generation fleet over the next 20 years.

2.1 The CLCPA

In June 2019, the New York legislature passed the Climate Leadership and Community Protection Act, which was then signed into law by Governor Cuomo in July. The CLCPA requires the NYSDEC to implement regulations, pursuant to the CLCPA and Article 75 of the ECL, that reduce GHG 40% (from 1990 levels) by 2030 and 85% by 2050. Statewide GHGs are defined in the CLCPA as the total annual emissions of GHGs produced within the state and GHGs produced outside of the state that are associated with the generation of electricity imported into the state and the extraction and transmission of fossil fuels imported into the state.[2] NYSDEC has yet to determine the 1990 baseline or promulgate the regulations required under the CLCPA.

Section 7(2) of the CLCPA requires all state agencies to consider whether the decision to issue permit(s) is inconsistent with or will interfere with the attainment of the GHG emission limits established in ECL Article 75.

The CLCPA also requires the NYPSC to implement a program to meet the targets of 70% of electricity to be sourced from renewable generation by 2030 and obtaining a statewide zero-emissions electrical system by 2040. This replaces the previous Clean Energy Standard (CES), which had set a target of 50% renewables by 2030. The CLCPA also formalizes New York's existing renewables targets: 6 GW of distributed solar by 2025 and 9 GW of offshore wind by 2035.

New York's aggressive environmental policies are pointing to $0/MWh marginal cost generation driving the market for the next ten years. For the purposes of this report, Navigant assumes full compliance with the decarbonization goals established by the CLCPA by 2030 and continued growth in renewables through 2040, but the analysis does include some variances in the specific resource mix to meet those goals. If successfully implemented, the CLCPA will result in widespread expansion of renewable and zero-carbon generation in the state.

2.2 NYSDEC Ozone Season NOx Emission Limits for Simple Cycle and Regenerative Combustion Turbines (6 NYCRR 227-3)

The NYSDEC has adopted stricter regulations that lower allowable NOx emissions from simple cycle and regenerative combustion turbines ("SCCT") during the ozone season to help address Clean Air Act ("CAA")

[2] *New York State Climate Leadership and Community Protection Act*

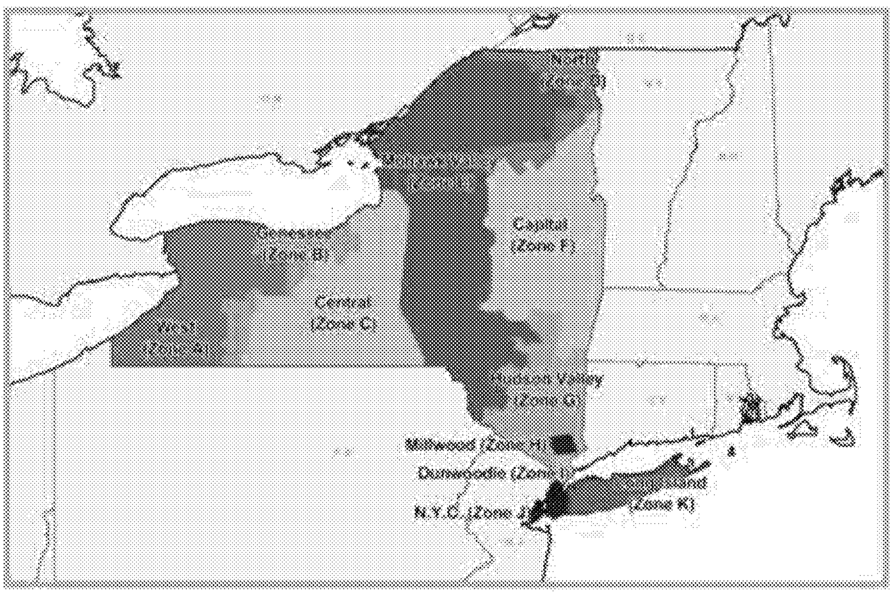
requirements and ozone nonattainment. The enactment of the Ozone Season NOx Emission Limits for Simple Cycle and Regenerative Combustion Turbines (6 NYCRR 227-3) phases in control requirements for SCCTs from 2023 to 2025. Specifically, the new rule sets a NOx emission limit of 100 parts per million (ppm) for all affected units by May 1, 2023. The limit is further reduced two years later to 25 ppm for units using gaseous fuels and to 42 ppm for units burning distillate oil or other liquid fuels. The existing, aging fleet of combustion turbine peaking units, can account for more than a third of the state's daily power plant NOx emissions when they run. The impact of this policy is expected to be the near-term retirement of 1,510 MW of capacity in New York City that must be replaced in order to maintain system reliability.

3. NEW YORK STATE'S POWER SYSTEM

3.1 History and Overview

New York is situated in the Northeast Power Coordinating Council region and has a mature, deregulated power market, with an established independent system operator (NYISO) and retail choice. The NYISO is an independent, not-for-profit system operator, and its service area is coterminous with New York State. It manages more than 400 market participants, schedules and dispatches over 500 electric power generators, and manages the flows on 11,173 miles of transmission lines on an hourly basis. Peak demand in the NYISO region reached 31,900 MW in 2018 with generation capability of 39,066 MW. NYISO consists of 11 load zones shown in Figure 3.

Figure 3: NYISO Load Zone Map



Source: Federal Energy Regulatory Commission

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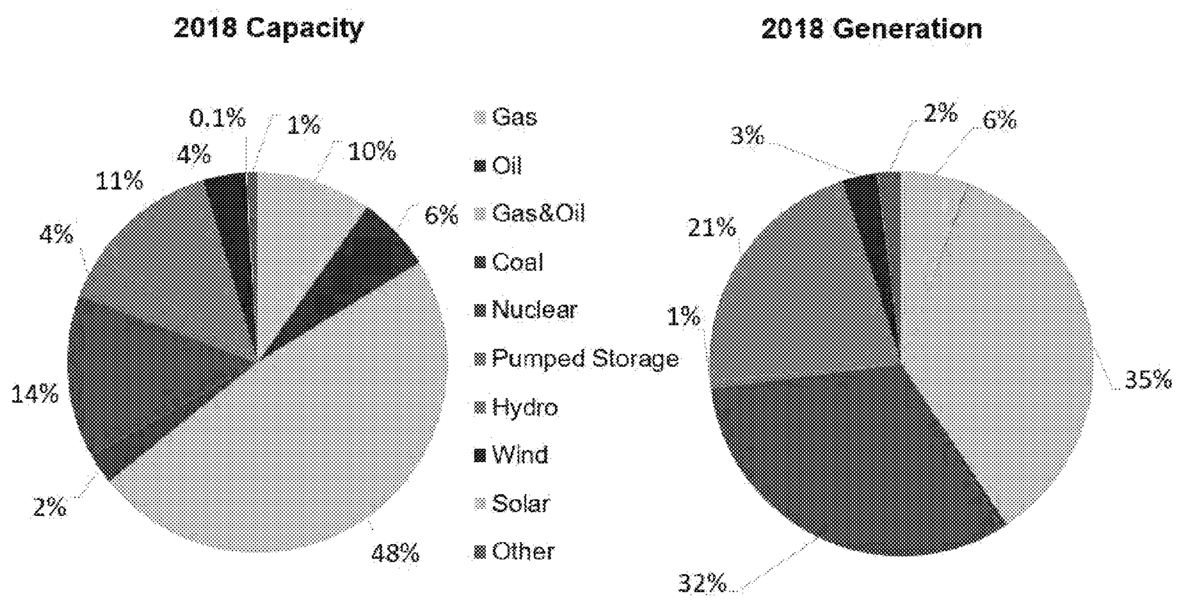
3.2 Current New York Supply Mix

The current resource mix in NYISO is diverse and relies primarily on nuclear, hydro and gas and oil units for generation, as seen in Figure 4. While technologically diverse, the current fleet is only about 37% decarbonized, and a significant amount of existing gas and oil generation will need to be replaced by renewables to reach New York's decarbonization goals. Nuclear units make up only 14% of capacity but provided 32% of generation in 2018 due to low variable costs. This will decline when Indian Point retires in 2020 and 2021. Similarly, conventional hydro units account for 11% of generation capacity while providing 21% of 2018 generation. Gas and gas/oil (dual fuel) units make up 58% of total generation capacity but accounted for only 41% of 2018 generation due to higher marginal costs.

Figure 4: NYISO 2018 Installed Capacity and Generation by Fuel Type



Source: Navigant Analysis

4. NEW YORK'S FUTURE RESOURCE MIX

The resource mix in New York and specifically New York City will need to change drastically over the next 20 years to meet the aggressive renewable targets and emissions reductions limits of the CLCPA, while maintaining reliable electric service. Navigant's forecast assumes that these targets and limits are met and includes large increases in renewable resources statewide.

As part of decarbonization, New York regulators passed new rules further restricting emission limits for thermal plants and incentivizing the phase out of older, less efficient peaking plants. Navigant's analysis involved assessing the current NYISO system and modeling the future changes to the resource mix to comply with the new policy targets and regulatory and environmental requirements.

New York City, as a large transmission constrained load center, causes complex challenges in completing the decarbonization. There will be a large amount of local capacity that will retire and need to be replaced. There also needs to be enough flexibility and long-term backstop to maintain operation and reliability even when variable generation from renewables is not available. In particular, the backstop generation will need to be available to operate as renewable generation varies by the hour, day and season.

The following sections describe the on-going changes and requirements in New York City and the broader NYISO over the next 20 years. As discussed in Section 5, decarbonizing New York City given its concentrated load, limited space for development, and transmission constraints is a key challenge, and a focus of the benefits of the Astoria Replacement Project.

4.1 New York City Retirements

Expected retirements in New York City are shown in Table 1 below. Approximately 1.5 GW of aging gas- and oil-fired combustion turbine ("CT") capacity, mostly used for peaking needs, is forecast to retire by 2026 due to stricter NOx emissions regulations. The replacement of aging thermal peaking capacity is one of the fundamental challenges facing New York City and its future ability to reliably meet peak needs and the CLCPA targets.

Table 1. NYC Plant Retirements (MW)

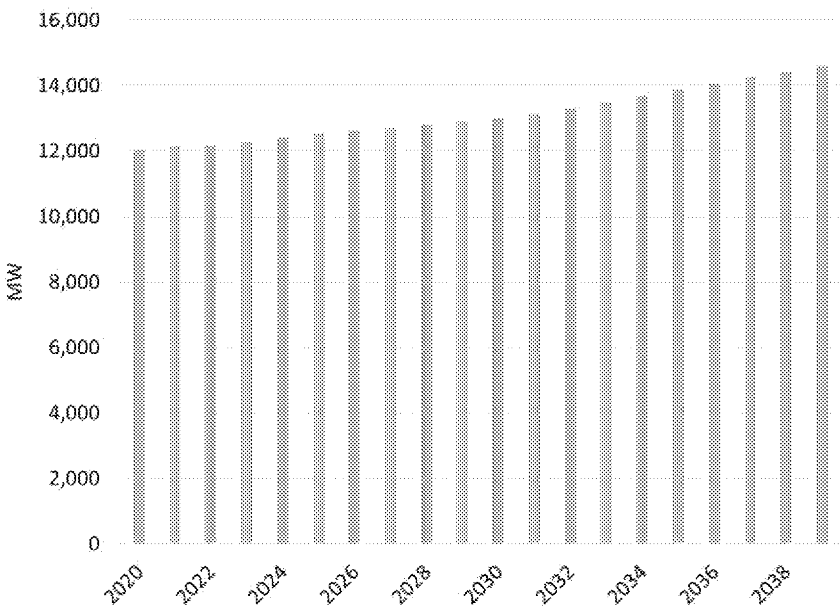
	CT Gas	CT Oil
2024	209	132
2025	905	137
2026	127	0

Source: Navigant Analysis

4.2 New York City Load Requirements

Peak load in New York City is forecast to gradually rise from ~11.9 GW in 2020 to 14.6 GW by 2040, as seen in Figure 5.[3] As New York City's load increases and thermal capacity retires, there will be challenges to meeting the City's reliability needs with the necessary peaking capacity. Overall reserve margins[4] are expected to drop significantly in 2021 and 2022 primarily due to the retirement of the Indian Point nuclear units. In our analysis, this capacity is anticipated to be quickly replaced with a variety of resources, including a notable amount of utility solar and offshore wind that is forecast to be online in the mid-2020s as New York moves towards its decarbonization targets. Energy efficiency and demand-side resources will also contribute to meeting this demand but the overall need for generation capacity will remain.

Figure 5. NYC Peak Demand (MW)



Source: Navigant Analysis

4.3 Future Resource Mix Statewide and in New York City

Navigant's forecast of capacity additions and retirements (shown in Figure 6) incorporates announced and generic solar and wind additions, which, if permitted and constructed as expected, are anticipated to help New York meet its obligations under the Regional Greenhouse Gas Initiative ("RGGI") and the CLCPA.

[3] Unlike the NYISO Gold Book, these peak load values are prior to incorporating the impacts from energy efficiency and demand response.

[4] Reserve margin is the capacity needed in addition to expected peak load to provide a backstop in case of even higher load combined with unit outages. Sufficient reserve margin must be maintained to sustain system reliability.

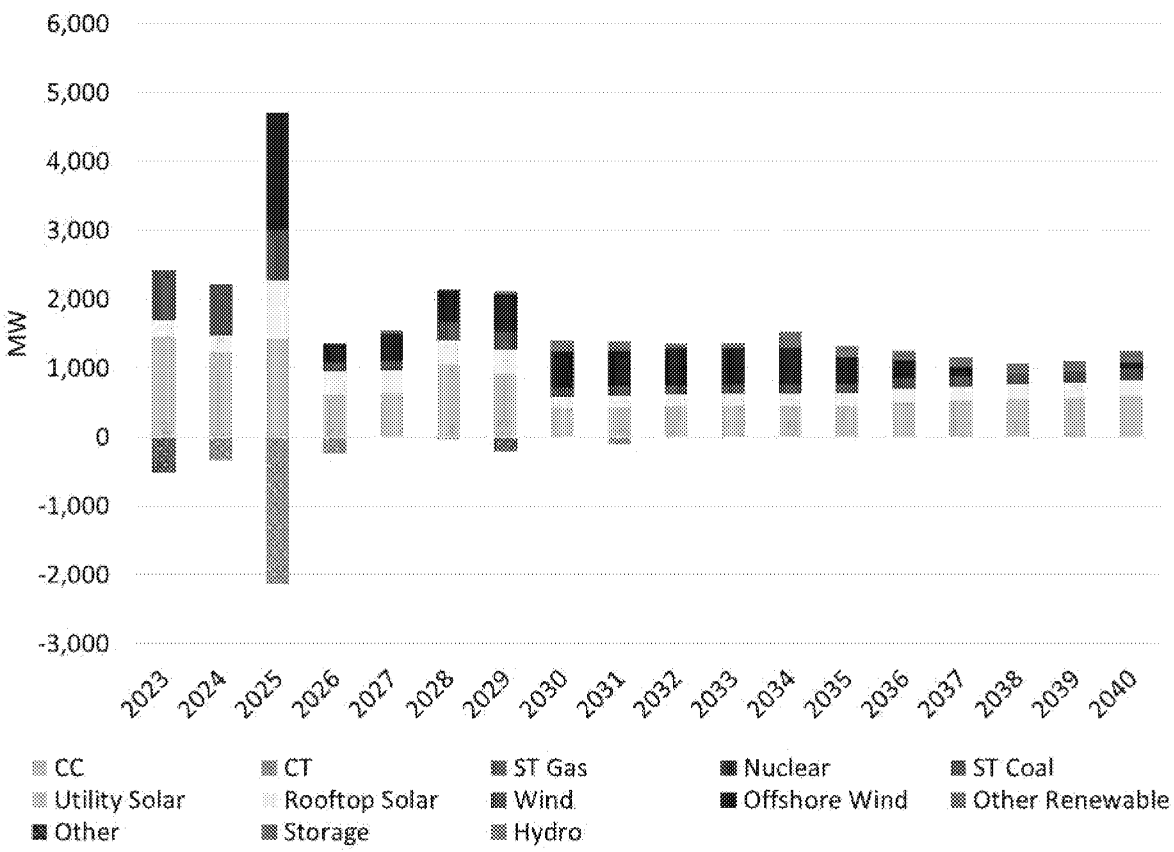
The steady addition of distributed solar throughout the forecast, driven by the CLCPA's goal of 6 GW of photovoltaic solar by 2025, further helps to meet reserve margin targets. Approximately 3.5 GW of rooftop solar is forecast to come online through 2030 as a key element of decarbonization.

Navigant forecasts 6.4 GW of offshore wind by 2035 connecting to New York City and Long Island, which is significant given that none of New York's electricity currently comes from offshore wind. Battery storage will play an increasingly important role as New York decarbonizes. It will help smooth the variability of intermittent solar and wind generation and shift generation to meet peak system needs as aging thermal peakers are retired due to stricter emissions regulations.

The two nuclear generators at Indian Point Units 2 and 3 are set to retire in 2020 and 2021, respectively, with a combined capacity of 2,045 MW. Approximately 1.5 GW of aging CT capacity, mostly used for peaking needs, is forecast to retire by 2026 due to stricter NOx emissions regulations in New York. Accordingly, the long-term build-out of new generation in our analysis also includes generic CTs and combined cycle combustion turbine generators as required to maintain both statewide and locational capacity requirements.

The replacement of the CT capacity is one of the central challenges facing New York City and its ability to maintain reliable operation of the system. Further discussion regarding the operation, flexibility and emissions of replacement capacity is provided in the following report sections.

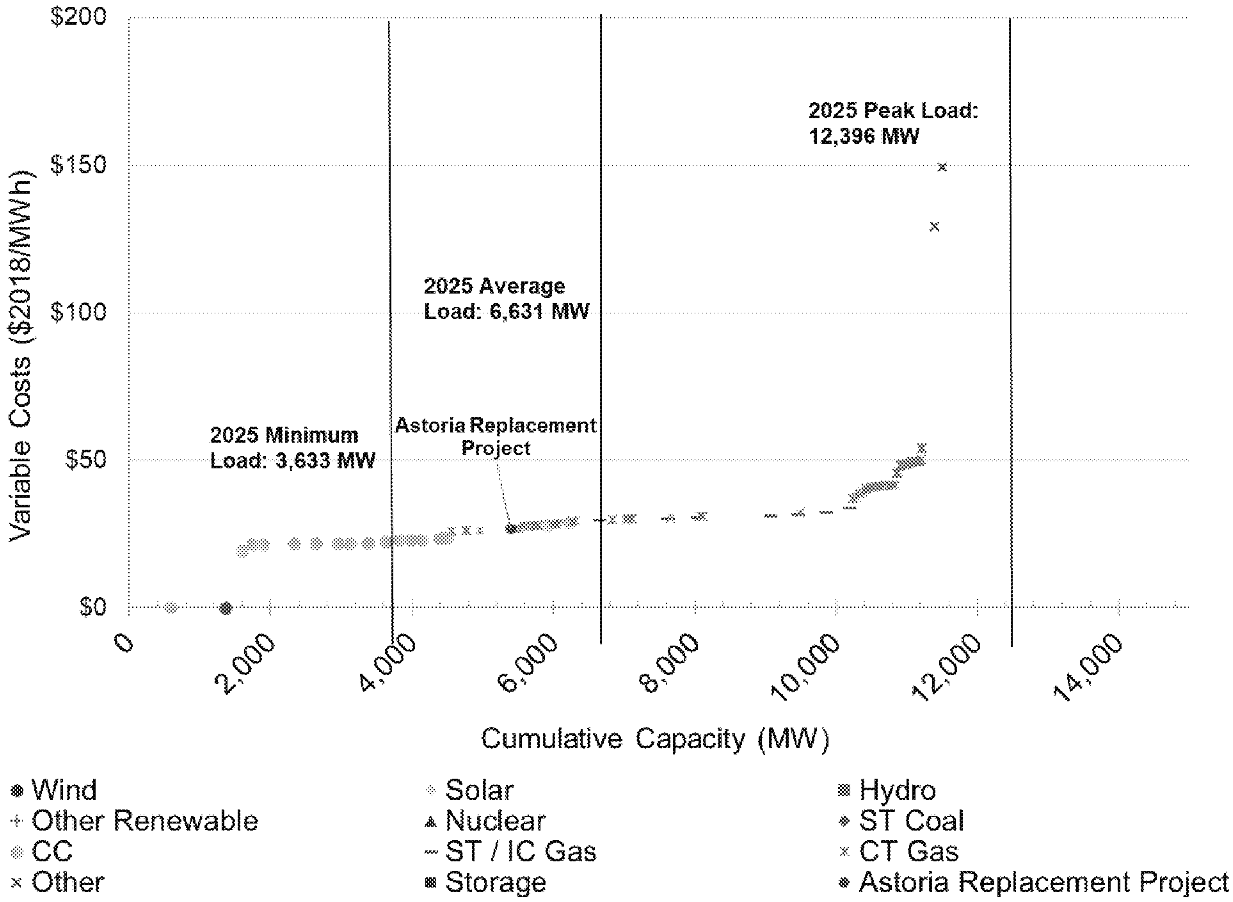
Figure 6. NYISO Capacity Additions and Retirements (MW)



Source: Navigant Analysis

The supply curve in Figure 7 below was created by taking all units in New York City and ordering them from least to most expensive cost of dispatch. This chart provides an illustrative method to determine economic merit order of units and the relative positioning of units versus demand. The supply curve shows that the Astoria Replacement Project is more efficient and therefore lower on the supply stack than other more GHG intensive, existing peaking combustion turbines.

Figure 7. New York City Supply Curve - 2025



Source: Navigant Analysis

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5. GHG REDUCTIONS FROM THE ASTORIA REPLACEMENT PROJECT

5.1 Direct Emissions Reductions

5.1.1 Evaluation Methodology

In order to assess the operations of the Astoria Replacement Project within the NYISO market, Navigant used its propriety dispatch optimization model, The Electric Value Model ("EVM"), to dispatch the new unit against future market conditions. These market conditions were created using PROMOD IV ("Promod"), a widely adopted production cost model.

Promod incorporates demand, generating operational characteristics, fuel prices, emissions prices, and transmission grid constraints to simulate system hourly operation in order to minimize the total operating cost while ensuring that generation and load are matched. The security constrained unit commitment and security constrained economic dispatch that are performed by the model are designed to mimic system operator commitment and dispatch. The key outputs of the simulation are the hourly details of system operation including generation by unit and the hourly locational marginal prices at each node. The key assumptions that were utilized in the model are discussed in Section 2.

Navigant then performed the dispatch of the Astoria Replacement Project given its specific unit characteristics provided by Astoria. Key characteristics provided included variable non-fuel operating and maintenance costs, ramp rate, minimum up and down time, seasonal capacity values, and heat rates. EVM generates a single unit's dispatch based on input forecast prices.

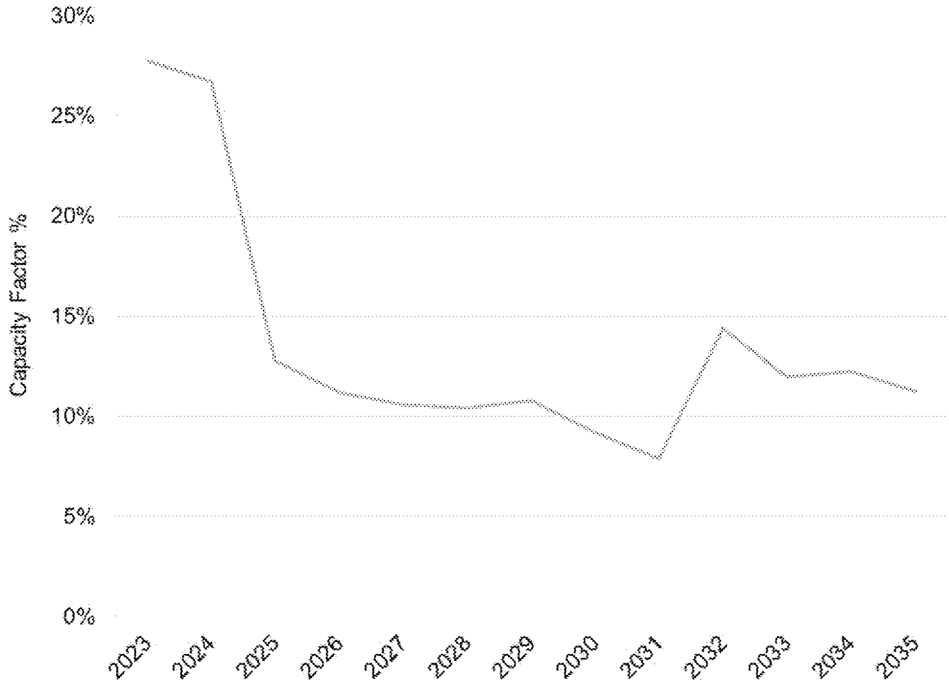
The emissions reduction was calculated by taking the hour by hour dispatch of the Astoria Replacement Project and determining which unit or units would have come online to replace that generation in each operating hour. The replacement generation was determined by looking at all resources within New York City and determining the least cost units that were not already generating. The emissions from the Astoria Replacement Project were then compared to the emissions of the replacement generation that would have been required had the Astoria Replacement Project not been available.

It is important to note that these estimates are conservative. As discussed in Section 5.1.4, natural gas production and transportation results in methane emissions that increase the GHG impacts of natural gas generation in the power sector. Since the Astoria Replacement Project replaces less efficient generation and reduces overall natural gas usage, it also reduces the GHG impacts from the extraction and transmission of natural gas imported into the state.

5.1.2 Forecasted Astoria Replacement Project Operation

The results from the dispatch analysis show that the Astoria Replacement Project is expected to have a wide variation in capacity factors through 2035, seen in Figure 8 below. As the NYISO system is forecast to integrate larger amounts of renewable resources, Astoria's capacity factor declines as the remaining energy needs on the system decrease. Notably, a large drop is forecast to occur in the mid-2020s due to offshore wind coming online and the replacement of several combustion turbines with new energy storage systems due to stricter NOx emissions regulations. Post-2031, the reserve margins fall in NY Zone J, which results in an uptick in capacity factor for Astoria.

Figure 8. Astoria Replacement Project Capacity Factor



Source: Navigant Analysis

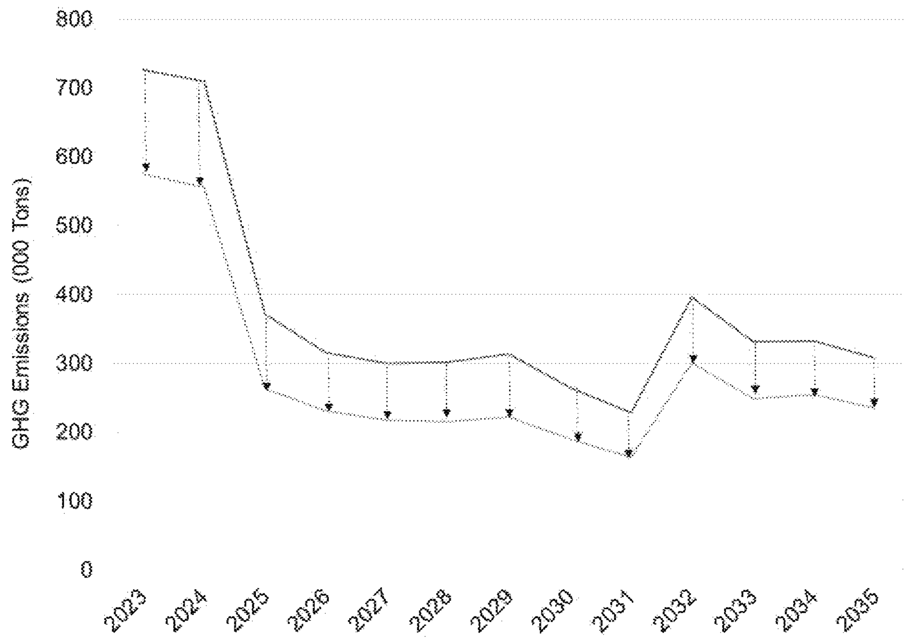
While the generation output of the Astoria Replacement Project declines over time as offshore wind is added to the system, it remains a key resource in providing valuable services needed for the reliable operation of the system especially with the addition of a significant amount of renewables. One such reliability and economic benefit is a result of the dual-fuel capability of the Project. This allows the Astoria Replacement Project to both help (i) mitigate energy prices during severe winter weather when fuel prices can spike and (ii) provide fuel security when natural gas must be prioritized for residential and commercial heating use instead of electric generation.

Due to the intermittency and covariance of renewable resource output, namely wind and solar, the capacity value of these resources decreases as more of any single technology type is added to a system. This is discussed in further detail in Section 5.2.2. As renewable resources continue to represent an increasingly larger portion of the New York City capacity mix, the Astoria Replacement Project serves as a critical capacity resource to maintain locational capacity requirements. Additionally, the changing net demand shape (electric demand net of renewable resource supply) also causes new and exacerbated stresses on the system as levels of renewable penetration are increased. High renewable systems have been shown to need both (1) additional quick response capability to account for unexpected variations in renewable generation, and (2) additional fast ramping capability to meet times of the day when renewable resources are not typically available. A modern combustion turbine resource such as the Astoria Replacement Project is well equipped to provide both of these services due to its quick start and its fast ramping capability. Sufficient quick start and fast ramping capabilities are key for a reliable transition to a high-renewable system.

5.1.3 Direct GHG Reduction from the Project

The Project provides direct reductions in greenhouse gas emissions. GHG emissions are reduced because the Astoria Replacement Project is significantly more efficient than other generation in New York City. Following commercial operation of the Project, generation from less efficient units will be directly displaced by generation from this Project.

Figure 9. GHG Emissions with and without Astoria Replacement Project



Source: Navigant Analysis; Arrows show reduction in GHG emissions with addition of Astoria Replacement Project.

Figure 9 shows both the annual emissions with and without the Astoria Replacement Project and Table 2 summarizes the annual emission reductions from the addition of the Project. The analysis shows an initial savings of over 150,000 tons of CO_2 in 2024. The direct GHG emissions from the Project trends downward as more renewable resources enter the system. However, as discussed in Section 5.2, indirect GHG emissions reductions from the Project rise significantly as the Project provides the capacity necessary to bring additional renewable resources on-line.

Over time, as overall system resources trend toward a zero-carbon emissions rate, the Astoria plant will operate at much lower capacity factors and serve primarily as a low-cost flexible resource to aid in system reliability and renewable integration. As the amount of renewables integration increases, the relative cost savings of capacity procured from the Astoria Replacement Project compared to equivalent capacity value procured from battery storage alone could be used to accelerate the construction of 543 MW of offshore wind resulting in an indirect GHG benefit of ~1M tons per year. For more detail, refer to Section 5.2.

Table 2. Annual Direct GHG Emissions Reduction with Astoria Replacement Project

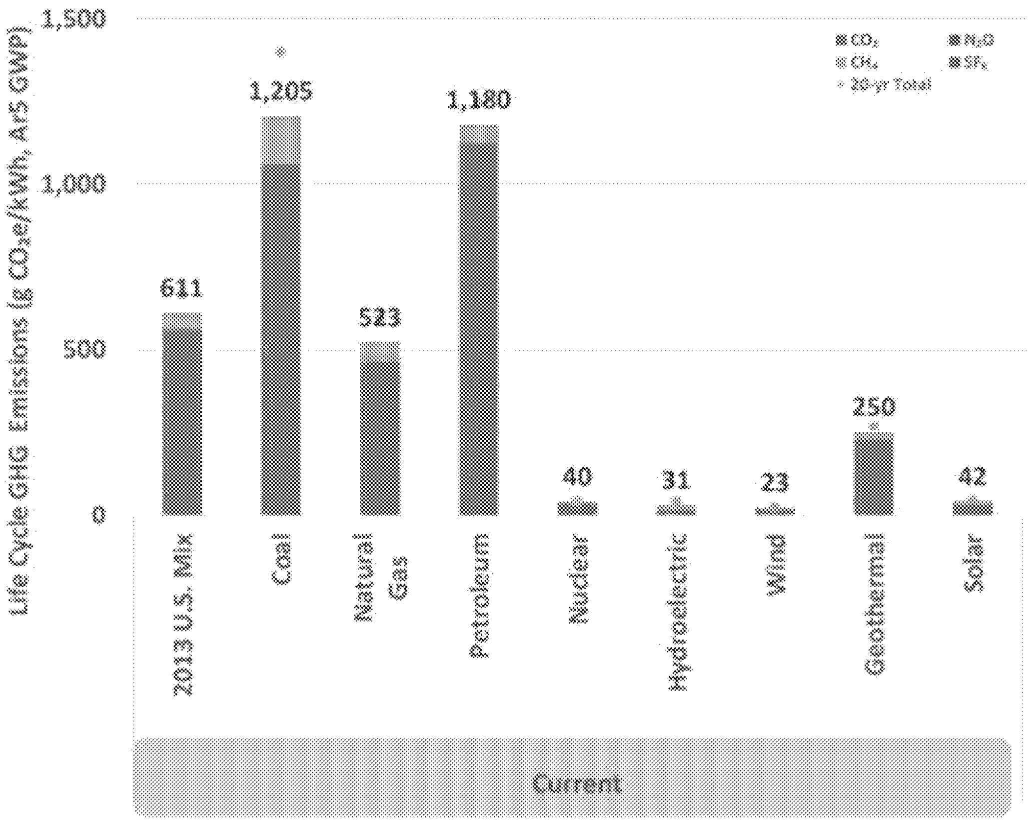
Year	Emissions Reduction	Cumulative Emissions Reduction
	(000 Tons)	
2023	151	151
2024	154	305
2025	108	413
2026	84	497
2027	82	579
2028	86	665
2029	91	756
2030	75	830
2031	65	896
2032	95	991
2033	82	1,073
2034	78	1,151
2035	72	1,223

Source: Navigant Analysis

5.1.4 Lifecycle Emissions for Natural Gas Generation

The direct emissions reductions calculated in Section 5.1.3 are conservative. Production and transportation of natural gas results in methane emissions, which are a potent GHG. The Astoria Replacement Project reduces overall natural gas generation by replacing the generation of less efficient units. This means the methane emissions from extracting natural gas and transmitting it to New York are also avoided, which increases the GHG benefit of the Project. Figure 10 shows the National Energy Technology Lab's estimate of the additional GHG emissions due to the natural gas production and transportation lifecycle. It increases the total emissions from natural gas by ~5%.

Figure 10. Lifecycle Emissions of Generating Technologies



Source: Presentation on Life Cycle Greenhouse Gas Emissions: Natural Gas and Power Generation, National Energy Technology Lab, 2015

5.2 Indirect GHG Reductions from the Astoria Replacement Project

This section discusses the challenges that will be faced by New York to complete full decarbonization as required by the CLCPA and the sizable indirect GHG emission reductions that can be realized from using the Astoria Replacement Project as a marginal capacity resource in the 2030's.

5.2.1 Requirements for a Power System Consistent with the CLCPA

The CLCPA targets decarbonization for the entire New York power system, but the biggest challenge will be how to complete the transition to 100% zero-carbon energy while maintaining the reliable operation of the power system in New York City especially given the size of the local demand, as well as the transmission constraints that limit the flow of power from elsewhere on the system. Article 75 of the ECL requires GHG be reduced 40% (from 1990 levels) by 2030 and 85% by 2050; and, the NYPSC to implement a program to meet the targets of 70% of electricity to be sourced from renewable generation by 2030 and shifting to a statewide electrical demand system of zero-emissions by 2040. Successfully and cost effectively meeting the CLCPA standards, targets and goals will require that the in-city power supply maintain sufficient levels of capacity to respond to unexpected outages, dips in renewable generation, or unexpectedly high local load.

Wind and solar power are intermittent resources in that their output varies with changes in weather patterns. Since electricity systems must always maintain balance between supply and demand across the system, this means that there must be resources that can respond (either by increasing generation or by decreasing generation) when there is a change in power supply from renewables. Solar power also varies through the day predictably as the sun rises and sets leading to large ramping requirements (increase or decrease) in the morning and evening that must be met by dispatchable system resources. Finally, renewable generation may have low availability over extended periods and there must be generation that can make up the difference over that entire period.

At a high level, there will need to be sufficient in-city generation or transmission capability to maintain system reliability as renewable resources are added to the system. Geographic and technological diversity of renewable generation resources helps mitigate these challenges, but there will still be a need for dispatchable generation, such as the Astoria Replacement Project, to ensure that the balance is maintained.

- Capacity Reserve – ensuring that there is sufficient generation capacity to meet unexpected peaks or unexpected outages.
- Energy Balance – ensuring that generation is always available to meet supply.
- Flexible Operations – ensuring that dispatchable generation levels can be changed either up or down quickly in response to changing system needs.

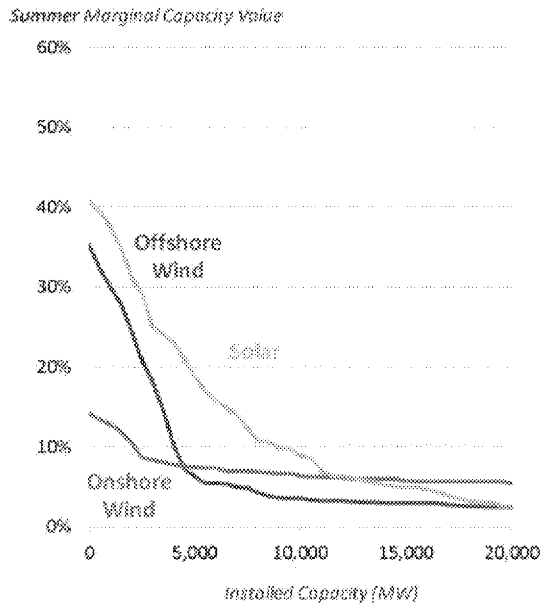
5.2.2 *Error! Reference source not found.* ***Flexible Gas Generation to Maximize GHG Reductions***

The CLCPA requires both GHG emissions to be reduced and decarbonization of the electrical system, in the most cost-effective manner. This provides an important role for gas generation to support the system as new technologies develop to ensure customer rates do not rise more than is necessary. The Astoria Replacement Project can fill this role and provide a flexible, cost effective, low capacity factor resource that supports a reduction in GHG emissions and overall decarbonization of the system, while maintaining system reliability.

Maintaining capacity reserve is particularly challenging in a high renewable system, as the effective ability of renewable resources to provide capacity declines as the penetration of those resources on the system increases. This concept is known as effective load carrying capacity ("ELCC"). Figure 11 from the NYISO Grid in Transition Study[5] shows the impact of this dynamic. The result is that capacity requirements must be made up by other firm technologies (dispatchable and non-interruptible).

[5] https://www.nyiso.com/documents/20142/2224547/Reliability-and-Market-Considerations-for-a-Grid-in-Transition-20191220%20Final.pdf/61a69b2e-0ca3-f18c-cc39-88a793469d50

Figure 11. ELCC of Wind and Solar

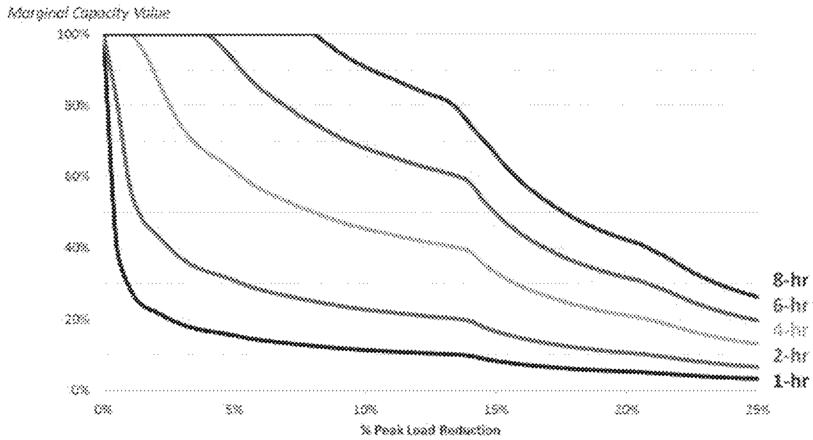


Source: Brattle Group, NYISO Grid in Transition Study (2020)

Each technology option for the New York City power system can help meet one or more of the above system requirements. The challenge for determining the most cost-effective path to meet the standards and targets of the CLCPA is how to balance technology choices with their capabilities and system needs.

In any CLCPA consistent resource plan for the New York electrical system, battery energy storage systems (battery storage or BESS) will be a very large component of the resource mix statewide and within New York City. BESS can provide all the needs of the system described in the previous section and is particularly equipped to ensure the system can respond to variations in renewable generation in a timely manner. However, the limiting factor for storage is the length of time a resource can provide power to the system before needing to be recharged. As BESS penetration increases, net peak periods flatten and longer discharge durations are required to provide the same capacity value that was provided by shorter duration resources when the system had less overall BESS penetration. This dynamic is described in the NYISO Grid in Transition Study and shown in Figure 12. The issue is that as the duration of a battery system increases, so do the capital costs and hence the costs that will be passed on to ratepayers.

Figure 12. Declining Marginal Capacity Value of Storage



Source: Brattle Group, NYISO Grid in Transition Study (2020)

Maintaining cost effective reliability is challenging due to the nature of the capacity reserve requirement whereby the marginal capacity resources on any system are largely needed for peak periods and emergency purposes and have relatively low capacity factors. In a system with fossil fuel generation, this role is often played by aging thermal units or combustion turbines. In a system with a significant share of energy storage providing capacity, the marginal capacity resources will require longer duration capability to provide the same capacity value. The result is deration of the capacity value of battery storage, and BESS becomes significantly more expensive as you continue to grow the amount of BESS that is part of the system capacity mix.

Keeping a small amount of gas generation on the system with a low capacity factor and low direct GHG emissions; has high capacity value and significantly lowers system cost. The savings from keeping this thermal generation rather than focusing on only batteries for capacity can be used to accelerate procurement of additional zero-carbon energy.

For example, the NYISO Grid in Transition Study assumes the following capital costs[6]:

Table 3. Technology Capital Costs

	L-I Battery (1 hr duration)	Combustion Turbine	Offshore Wind
		($/kW)	
2020	$347	$1,274	$4,369
2030	$234	$1,154	$3,251

Source: NYISO Grid in Transition Study, 2020

A 4-hour duration battery is needed to provide full capacity in 2020 which has a capital cost of $1,388 vs. $1,274 for the combustion turbine. However, using current technologies and expected technology costs, if New York City replaces roughly half of current peaking resources (~3,000 MW) with battery storage, the

[6] Assumes 3% increase for downstate battery storage compared to upstate and 43% increase for combustion turbine downstate compared to upstate as reported in EIA's AEO 2020 Capital Cost Assumptions Report.

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penetration of battery storage would be close to 25% for the city's capacity resources. In this case, consistent with Figure 12, even 8-hour duration batteries only count for 30% of their nameplate capacity. The battery storage cost per kW of firm capacity is thereby:

$$\$234/\text{kWh} * 8 \text{ (hr duration)} * (100/30) = \$6{,}240/\text{kW}$$

The $6,240/kW for BESS compares with a cost of only $1,154/kW for a combustion turbine to provide the same capacity value to the system, a savings of more than 80 percent.

As described in Section 5.1.2, the Astoria Replacement Project is expected to have a low capacity factor after 2030 due to the expected addition of BESS and renewable resources to the system. With a 10% capacity factor, the direct emissions of the Project are ~200,000 tons per year. While a battery would not have these direct emissions, they would not be able to provide the same level of indirect GHG emission reductions that the Astoria Project can. If the savings from using the Astoria Replacement Project as capacity versus a battery are used to accelerate renewables, an additional 543 MW of offshore wind could be procured. Assuming a conservative 50% capacity factor, this results in ~2,400 GWh of generation per year from thermal resources that can be replaced with the additional wind. The GHG benefit of this is ~1,000,000 tons per year, which dwarfs the direct emissions from the Astoria Replacement Project.

The Astoria Replacement Project uses a modern, highly flexible combustion turbine, so it can also support the system in maintaining sufficient flexibility when it is operating. This means that it does not have to be directly supplemented with energy storage to provide those capabilities.

5.2.3 The Role of the Astoria Replacement Project Post - 2040

One important implication of battery storage being derated as a capacity resource as penetration increases is there needs to be technological advances over the next 20 years to fully decarbonize the power system in a cost-effective manner. It is not yet clear what technologies will emerge, but one key option includes converting gas generation to hydrogen fuel. The turbine technology selected by the Astoria Replacement Project is capable of being converted to use hydrogen in the future instead of natural gas or fuel oil. This positions the Project to operate post 2040 within a zero-carbon electric grid (consistent with the CLCPA) while continuing to provide multiple benefits to the bulk power system.

Appendix F.2

Navigant/Guidehouse February 2021 GHG Supplement

Supplement to GHG Impacts of Astoria Replacement Project

Prepared for Astoria Gas Turbine Power LLC

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February 2021

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DISCLAIMER

This report was prepared by Guidehouse Consulting, Inc., ("Guidehouse"),[1] for Astoria Gas Turbine Power LLC ("Astoria"). The work presented in this report represents Guidehouse's professional judgment based on the information available at the time this report was prepared. Guidehouse is not responsible for the reader's use of, or reliance upon, the report, nor any decisions based on the report. GUIDEHOUSE MAKES NO REPRESENTATIONS OR WARRANTIES, EXPRESSED OR IMPLIED. Readers of the report are advised that they assume all liabilities incurred by them, or third parties, as a result of their reliance on the report, or the data, information, findings and opinions contained in the report.

[1]Guidehouse was formerly known as Navigant Consulting.

EXECUTIVE SUMMARY

Astoria Gas Turbine Power LLC ("Astoria") is proposing to modify its previously permitted 1,040 MW project to replace twenty four nearly 50-year-old Pratt & Whitney ("P&W") combustion turbines and seven recently retired Westinghouse combustion turbines at Astoria with a new, state-of-the-art, H-class simple cycle combustion turbine generator ("CTG") (the "Astoria Replacement Project" or the "Project"). The P&W units are set to retire by May 2023. The need for the Replacement Project is driven by the anticipated impacts of climate change policies and regulatory frameworks that are pushing modernization and decarbonization of the New York Independent System Operator ("NYISO") and especially the New York City generation fleet.

The purpose of this report is to supplement the June 17, 2020 *GHG Impacts of the Astoria Replacement Project* report describing the greenhouse gas ("GHG") emissions impacts of the Astoria Replacement Project and how the Project is consistent with the New York State Climate Leadership and Community Protection Act ("CLCPA"). This report revises the June 17, 2020 report based on comments from the New York State Department of Environmental Conservation ("NYSDEC") and incorporates Guidehouse's latest forecast for capacity additions and retirements, as well as an updated load forecast. Based on the GHG reductions that will result from the Astoria Replacement Project, it is consistent with the State's attainment of the Article 75 GHG reductions, and 6 NYCRR 496 Statewide Greenhouse Gas Emission limits for 2030 and 2050.

The CLCPA requires the NYSDEC to implement regulations, pursuant to the CLCPA and Article 75 of the New York Environmental Conservation Law ("ECL"), that reduce Statewide GHG emissions 40% (from 1990 levels) by 2030 and 85% by 2050. NYSDEC finalized the 2030 and 2050 Statewide Greenhouse Gas Emission limits in the 6 NYCRR 496 regulations on December 30, 2020. The 2030 statewide limit is 245.87 million metric tons of CO2e, and the 2050 limit is 61.47 million metric tons CO2e. The CLCPA also requires the New York Public Service Commission ("NYPSC") to implement a program to meet the targets of 70% of electricity to be sourced from renewable generation by 2030 and obtain a statewide zero-emissions electrical system by 2040. While the CLCPA regulations and programs have not yet been fully developed by NYSDEC or NYPSC, Section 7(2) of the CLCPA requires all state agencies to consider whether the decision to issue permit(s) is inconsistent with or will interfere with the attainment of the GHG emission limits established in ECL Article 75 and Part 496.

This analysis evaluates the impact of the Project on statewide GHG emissions based on full compliance with the CLCPA's targets and limits.[2] The results show that the Project is consistent with the CLCPA and provides significant GHG emission reductions. The Project minimizes costs and maximizes benefits to New York via the following mechanisms:

- Direct GHG reductions through displacement of older, less efficient generation. The Project also causes a reduction in upstream GHG emissions associated with the extraction and transmission of the fuels that the displaced units would otherwise use.[3]
- Indirect GHG reductions by providing required quick start and fast ramping capacity to maintain reliability in New York City. This allows New York to avoid the installation of very large amounts

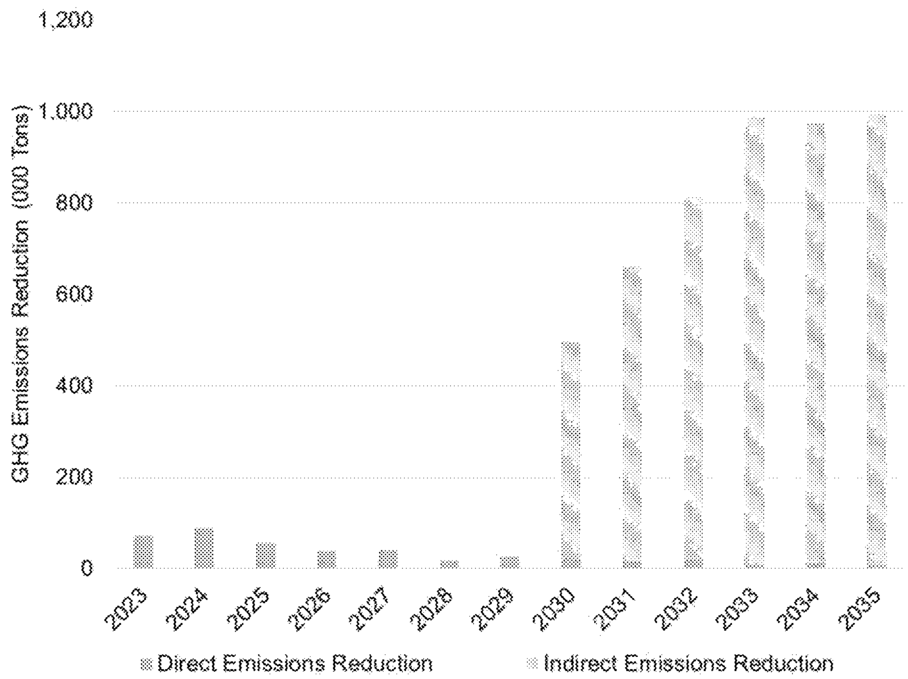
[2] All figures and charts are from Guidehouse analysis, unless otherwise noted.

[3] Quantification of the GHG emission reductions caused by the Project that are associated with the extraction and transmission of fossil-fuels that would otherwise occur from the operation of the displaced units, is not included in this report.

of marginal capacity from energy storage, the cost savings of which can be applied to accelerate procurement of additional renewable resources including significant amounts of offshore wind.

Figure 1 shows the annual direct and indirect GHG emissions reductions due to the Project based on (i) comparing emissions from the Project with emissions from replacement generation that would be required without the Project[4] and (ii) additional renewable generation that can be added to the system from cost savings attributable to the Project. The cumulative reduction of GHG emissions caused by the Project through 2035 is approximately 5.3 million tons. Post-2035, emissions are still reduced by the Project, but the quantity depends on how the New York electric system ultimately reaches full decarbonization and whether (and when) the Project starts to generate electricity using green hydrogen fuel.

Figure 1. GHG Benefits of Astoria Replacement Project



Source: Guidehouse Analysis; Note: 2023 includes June – December 2023 only.

Table 1. Emissions Reduction from Astoria Replacement Project

Astoria Replacement Project Avoided CO2 (000 Tons)

[4] In all analyses, the existing Astoria generating units are assumed to retire in May 2023. As a result, the GHG emission reduction benefits from the Replacement Project do not include any credit from the retirement of the existing units.

Year	Direct Emissions Reduction		Indirect Emissions Reduction
	New York	From Imported Electricity	
2023	72	0.09	
2024	88	0.05	
2025	57	0.03	
2026	38	0.14	
2027	40	0.04	
2028	18	0.05	
2029	27	-0.02	
2030	21	0.00	476
2031	15	0.05	646
2032	19	-0.04	792
2033	7	0.10	979
2034	13	0.08	961
2035	5	-0.02	990

Source: Guidehouse Analysis. Note: 2023 includes June – December 2023 only.

The Project is also consistent with the long-term electricity targets and goals of the CLCPA, which require 70% of electricity statewide to be sourced from renewables by 2030, shifting to zero-carbon emission generation by 2040.The Project will enable additional renewables to be added to the system and the Project's CTG technology is capable of being converted to use green hydrogen as fuel once it becomes available in sufficient quantities via a commercial delivery system such as the existing natural gas pipeline system.

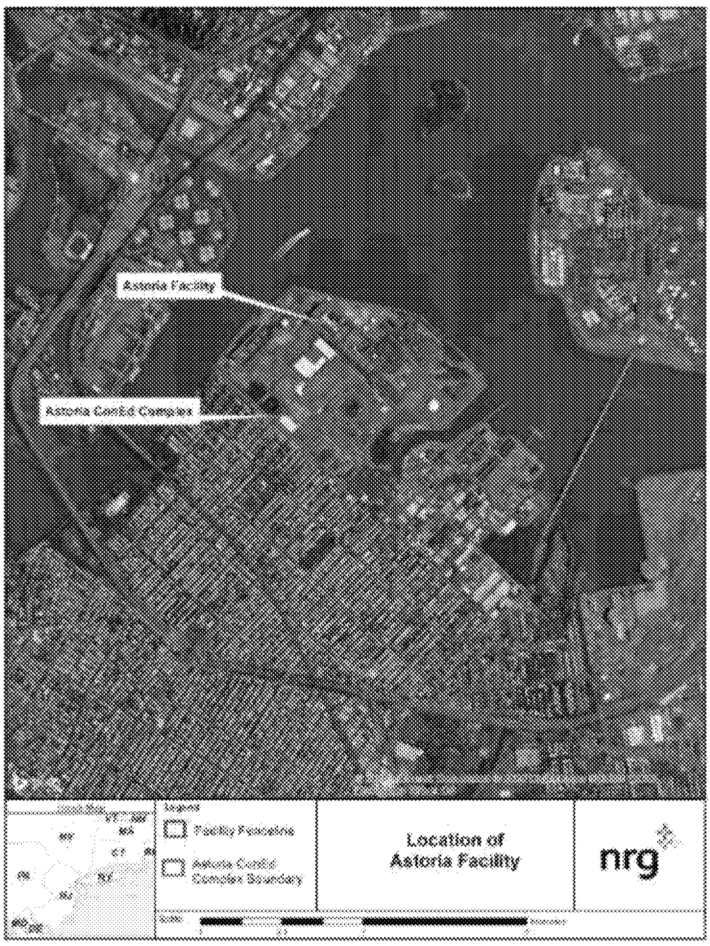
1. ASTORIA REPLACEMENT PROJECT

The Astoria Replacement Project is being developed at the approximately 15.7-acre Astoria Gas Turbine Facility ("the Facility") located at 31-01 20th Ave., Astoria, Queens County, New York, situated within a large 600+ acre complex (referred to as the "Astoria ConEd Complex") shown in Figure 2. The Facility currently consists of 31 older, dual-fuel (natural gas and ultra-low sulfur kerosene) combustion turbine generators including 24 Pratt & Whitney turbines and seven retired Westinghouse turbines, with a combined nameplate rating of 646 megawatts ("MW"). These P&W units are slated to retire in May 2023.

Astoria is proposing to modify its previously approved project. The Project will replace the 50-year-old P&W and previously retired Westinghouse CTGs at the Facility with a new, state-of-the-art, dual fuel, simple cycle combustion turbine generator unit. The proposed replacement unit (General Electric 7HA.03 or equivalent) has a nominal generator output of approximately 437 MW.

All of the existing units, with the exception of one P&W Twin Pac (consisting of two combustion turbines and a single generator), will be permanently shut down once the new unit has completed its shakedown period. The two remaining P&W turbines will remain operational solely to provide black-start capability until replaced by an approximately 24 MWe battery energy storage system ("BESS").

Figure 2. Astoria Replacement Project Site Location



Source: AECOM

2. NEW YORK'S FUTURE RESOURCE MIX

The resource mix in New York and specifically New York City will need to change drastically over the next 20 years to meet the aggressive renewable targets and emissions reductions limits of the CLCPA, while maintaining reliable electric service. Guidehouse's forecast assumes that these targets and limits are met, and includes large increases in renewable resources statewide.

In addition to the CLCPA and its implementing regulations, New York also promulgated 6 NYCRR 227-3 (known as the Peaker Rule) further restricting oxides of nitrogen ("NOx") emission from simple cycle combustion turbines thereby incentivizing the phase out of older, less efficient peaking plants starting in 2023. Guidehouse's analysis involved assessing the current NYISO system and modeling the future changes to the resource mix to comply with the new policy targets and regulatory and environmental requirements. As such, this analysis assumes the existing Astoria generating units are not in operation after May 1, 2023 and that the Project will begin commercial operation in June 2023.

New York City, as a large transmission constrained electricity load center, causes complex challenges in meeting New York's decarbonization goals. There will be a large amount of local peaking capacity that will retire and need to be replaced. There also needs to be enough flexibility and long-duration backup to maintain operation and reliability of the electric system even when variable generation from renewables is not available. In particular, this backstop generation will need to be available to operate as renewable generation varies by the hour, day and season.

The following sections describe the on-going changes and requirements in New York City and the broader NYISO over the next 20 years. As discussed in Section 3, decarbonizing New York City given its concentrated load, limited space for development, and transmission constraints is a key challenge, and a focus of the benefits of the Astoria Replacement Project.

2.1 New York City Retirements

Expected retirements of existing electric generating units in New York City are shown in Table 2 below. Approximately 1.5 GW of aging gas-and oil-fired combustion turbine ("CT") capacity, mostly used for peaking needs, is forecast to retire by 2026 due to stricter NOx emissions regulations. The replacement of peaking capacity provided by these aging units is one of the fundamental challenges facing New York City and its future ability to reliably meet peak needs while also meeting the CLCPA targets.

Table 2. NYC Plant Retirements (MW)

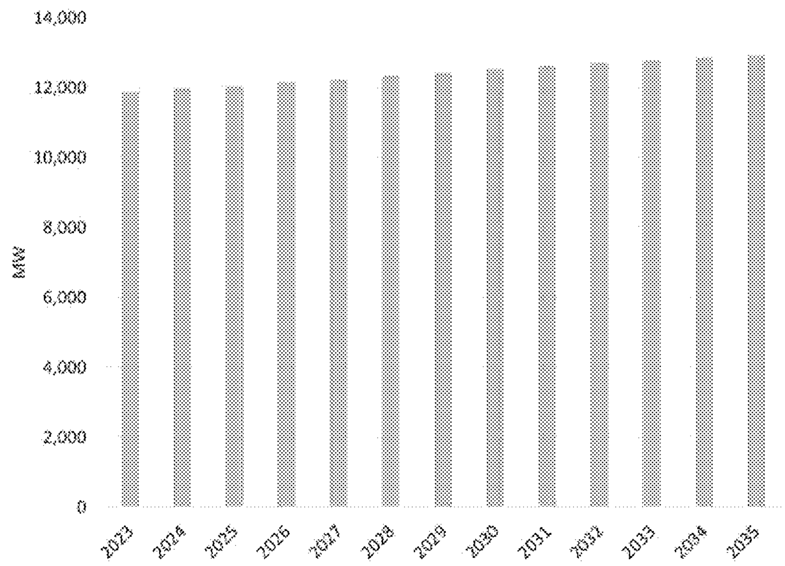
	CT Gas	CT Oil
2022	155	122
2023	387	0
2024	101	117
2025	75	15
2026	523	15

Source: Guidehouse Analysis

2.2 New York City Load Requirements

Peak load in New York City is forecast to gradually rise from ~11.9 GW in 2020 to 14.6 GW by 2040, as seen in Figure 3.[5] As New York City's load increases and aging capacity retires, there will be challenges to meeting the City's reliability needs with the necessary peaking capacity. Overall reserve margins[6] are expected to drop significantly in 2021 and 2022 primarily due to the retirement of the Indian Point nuclear units. In our analysis, this capacity is anticipated to be replaced with a variety of resources, including a notable amount of utility solar and offshore wind that is forecast to be online in the mid-2020s as New York moves towards its decarbonization targets. Energy efficiency and demand-side resources will also contribute to meeting this demand but the overall need for generation capacity will remain.

Figure 3. NYC Peak Demand (MW)



Source: 2020 NYISO Gold Book (Issued April 2020)

2.3 Future Resource Mix Statewide and in New York City

Guidehouse's forecast of capacity additions and retirements (shown in Figure 4) incorporates announced and generic solar and wind additions, which, if permitted and constructed as expected, are anticipated to help New York meet its CLCPA and Regional Greenhouse Gas Initiative ("RGGI") obligations.

Guidehouse forecasts that most of the additions over the study period are solar (utility PV and rooftop), wind (onshore and offshore) and battery energy storage systems ("BESS"). For battery energy storage, Guidehouse expects near-term projects to be built for 4 hours of energy duration, transitioning to 6 hour batteries in 2027 and 8 hours in 2031.The build forecast also includes generic natural gas fired CTs coming online in downstate zones from 2022 until 2024, which are needed to replace aging CTs and meet local reserve margin targets in the short-term.

---

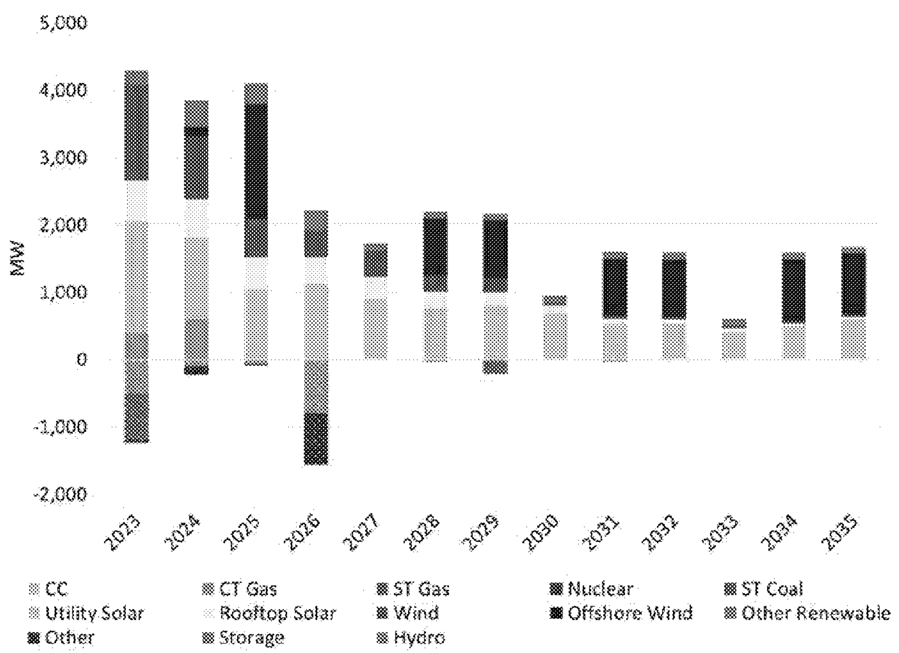
[5] Unlike the NYISO Gold Book, these peak load values are prior to incorporating the impacts from energy efficiency and demand response; Guidehouse used gross peak load in its supply and demand forecast.

[6] Reserve margin is the capacity needed in addition to expected peak load to provide a backstop in case of even higher load combined with unit outages. Sufficient reserve margin must be maintained to sustain system reliability.

Guidehouse forecasts approximately 13.3 GW of utility and rooftop solar additions and 2 GW of energy storage by 2030 to comply with CLCPA mandates. In order to maintain reliability and balance large amounts of renewables, longer duration storage will be needed as renewables make up more of NYISO's generation capacity mix. Longer-duration storage will be needed to provide the same grid capabilities that shorter-duration batteries previously did. 7 GW of offshore wind is expected to come online in New York City and Long Island by 2035. In terms of retirements, the second nuclear generator at Indian Point 3 (1,025 MW) is set to go offline in 2021, approximately 1.5 GW of CT and ST fossil-fueled generating capacity in New York City is expected to retire by 2026.

The replacement of the CT capacity is one of the central challenges facing New York City and its ability to maintain reliable operation of the system, particularly with the increase in intermittent renewables that are expected to be added. Further discussion regarding the operation, flexibility and emissions of replacement capacity is provided in the following report sections.

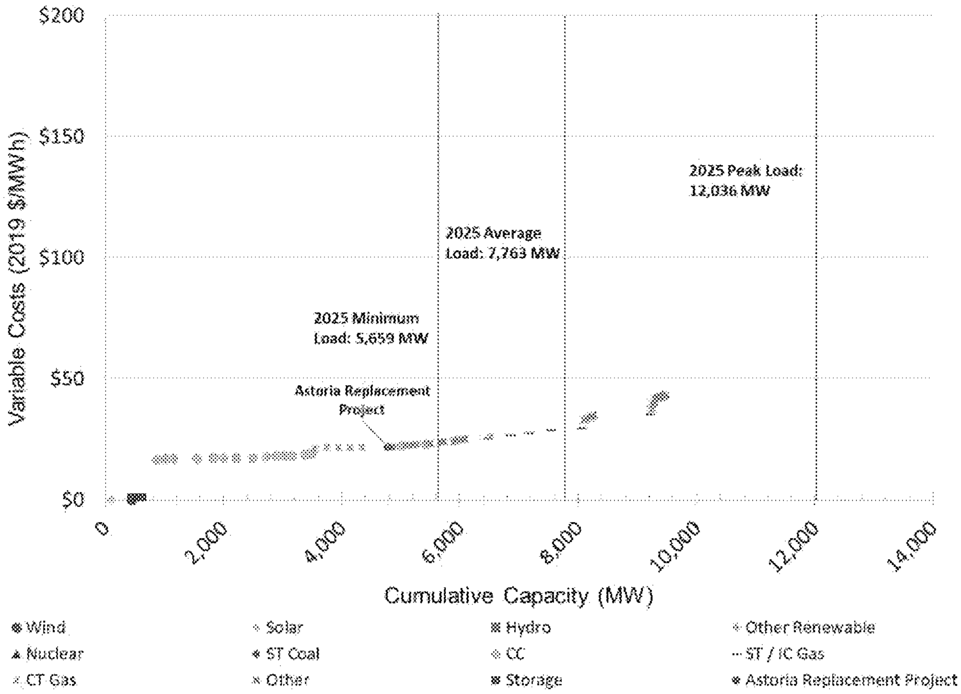
Figure 4. NYISO Capacity Additions and Retirements (MW)



Source: Guidehouse Analysis

The supply curve in Figure 5 below was created by taking all units in New York City and ordering them from least to most expensive cost of dispatch. This chart provides an illustrative method to determine economic merit order of units and the relative positioning of units versus demand. The supply curve shows that the Astoria Replacement Project is more efficient and therefore lower on the supply stack than other more GHG-intensive existing generation in the area.

Figure 5. New York City Supply Curve - 2025



Source: Guidehouse Analysis

3. GHG REDUCTIONS FROM THE ASTORIA REPLACEMENT PROJECT

3.1 Direct Emissions Reductions

3.1.1 Evaluation Methodology

In order to assess the operations of the Astoria Replacement Project within the NYISO market, Guidehouse used its propriety dispatch optimization model, The Electric Value Model ("EVM"), to dispatch the new unit against future market conditions. These market conditions were created using PROMOD IV ("Promod"), a widely adopted production cost model.

Promod incorporates demand, generating operational characteristics, fuel prices, emissions prices, and transmission grid constraints to simulate system hourly operation in order to minimize the total operating cost while ensuring that generation and load are matched. The security constrained unit commitment and security constrained economic dispatch that are performed by the model are designed to mimic system operator commitment and dispatch. The key outputs of the simulation are the hourly details of system operation including generation by unit and the hourly locational marginal prices at each node. The key assumptions that were utilized in the model are discussed in Section 2.

Guidehouse then performed the dispatch of the Astoria Replacement Project given its specific unit characteristics provided by Astoria. Key characteristics provided included variable non-fuel operating and maintenance costs, ramp rate, minimum up and down time, seasonal capacity values, and heat rates. EVM generates a single unit's dispatch based on input forecast prices.

The emissions reduction was calculated by taking the hour by hour dispatch of the Astoria Replacement Project and determining which unit or units would have come online to replace that generation in each operating hour. The replacement generation was determined by looking at all resources able to supply the electricity needed and determining the least cost units that were not already generating. The existing Astoria units were not considered as replacement generation, since they are assumed to be shutdown prior to the Project beginning commercial operation. The emissions from the Astoria Replacement Project were then compared to the emissions of the replacement generation that would have been required had the Astoria Replacement Project not been available.

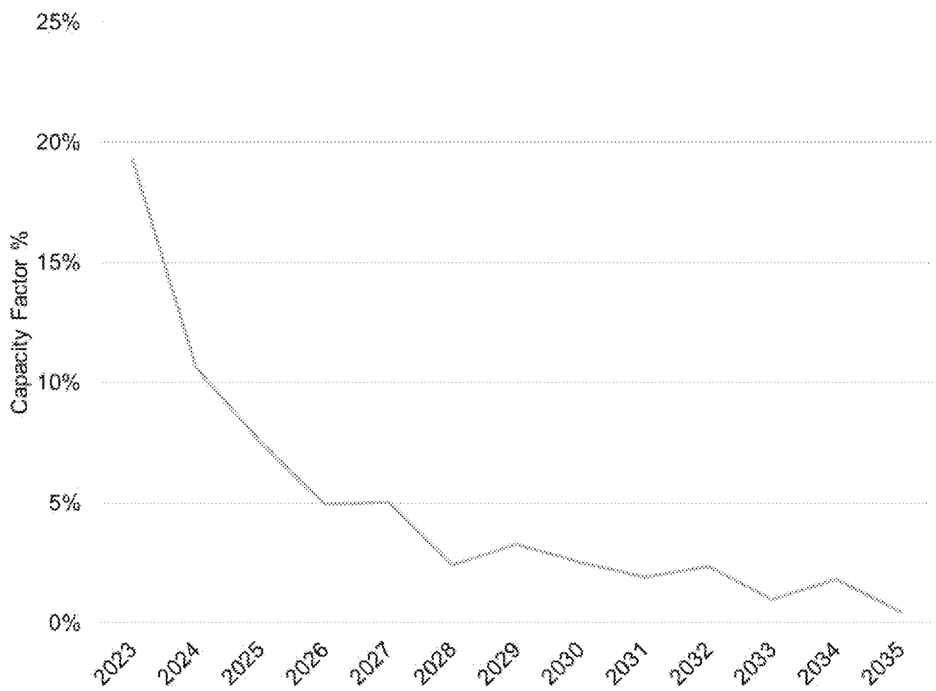
As part of the direct emissions reductions analysis, Guidehouse calculated the GHG reduction due to displacement of imported electricity that the Project would replace. We took the difference in imports from the Astoria Replacement Project Case and the Base Case and multiplied it by the Import Marginal Emission Intensity (IMEI) of 0.49 Tons CO_2/MWh. The IMEI corresponds to the average emission intensity of gas plants that operate at a lower than 60% capacity factor – consistent with the California Air Resources Board (CARB) carbon accounting framework used to estimate the GHG emission reductions between cases.

It is important to note that the estimates in this report are conservative. As discussed previously, natural gas production and transportation results in emissions that increase the GHG impacts of natural gas generation in the power sector. Since the Astoria Replacement Project replaces less efficient generation and reduces overall natural gas usage, it also reduces the GHG impacts from the extraction and transmission of natural gas imported into the state. The impact of the Project on reducing these upstream emissions are not included in this report.

3.1.2 Forecasted Astoria Replacement Project Operation

The results from the dispatch analysis show that the Astoria Replacement Project is expected to have a wide variation in capacity factors through 2035, seen in Figure 6 below. As the NYISO system is forecast to integrate larger amounts of renewable resources, Astoria's capacity factor declines as the remaining energy needs on the system decrease. Nevertheless, the Astoria Replacement Project still replaces the operation of more GHG-intensive existing electric generators resulting in GHG emission reductions.

Figure 6. Astoria Replacement Project Capacity Factor



Source: Guidehouse Analysis. Note: 2023 includes June – December 2023 only.

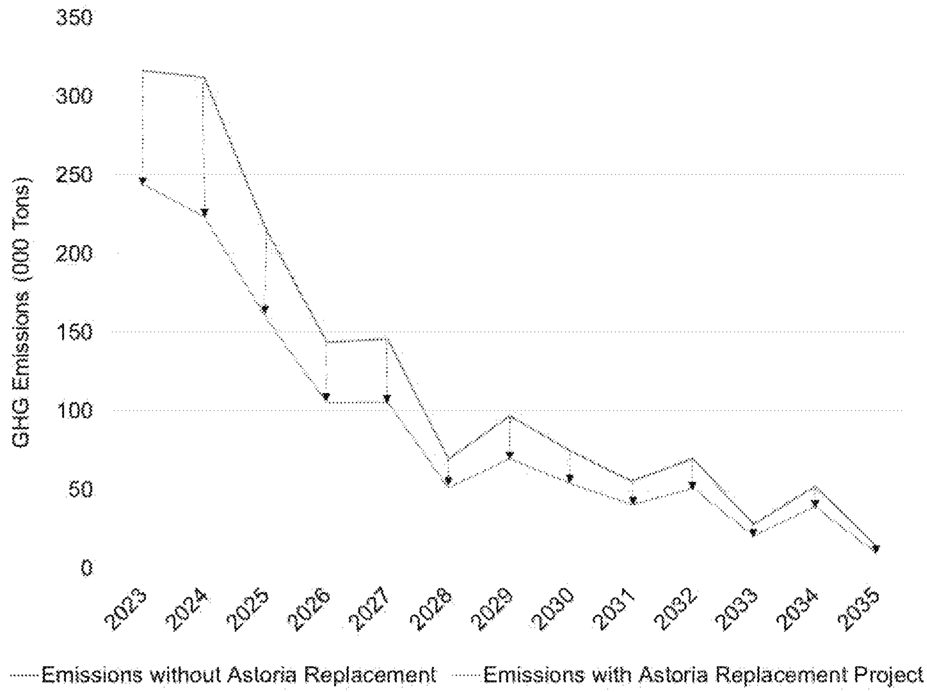
While the generation output of the Astoria Replacement Project declines over time as offshore wind is added to the system, it remains a key resource in providing valuable services needed for the reliable operation of the electric system especially with the addition of a significant amount of renewables. One such reliability and economic benefit is a result of the dual-fuel capability of the Project. This allows the Astoria Replacement Project to both help (i) mitigate energy prices during severe winter weather when fuel prices can spike and (ii) provide fuel security when natural gas must be prioritized for residential and commercial heating use instead of electric generation.

Due to the intermittency and covariance of renewable resource output, namely wind and solar, the capacity value of these resources decreases as more of any single technology type is added to a system. As renewable resources continue to represent an increasingly larger portion of the New York City capacity mix, the Astoria Replacement Project serves as a critical capacity resource to maintain locational capacity requirements. Additionally, the changing net demand shape (electric demand net of renewable resource supply) also causes new and exacerbated stresses on the system as levels of renewable penetration are increased. High renewable systems have been shown to need both (1) additional quick response capability to account for unexpected variations in renewable generation, and (2) additional fast ramping capability to meet times of the day when renewable resources are not typically available. A modern combustion turbine resource such as the Astoria Replacement Project is well equipped to provide both of these services due to its quick start and its fast ramping capability. Sufficient quick start and fast ramping capabilities are key for a reliable transition to a high-renewable system.

3.1.3 Direct GHG Reduction from the Project

The Project provides direct reductions in greenhouse gas emissions. GHG emissions are reduced because the Astoria Replacement Project is significantly more efficient than other generation capable of supplying electricity to New York City. Following commercial operation of the Project, generation from less efficient units will be directly displaced by generation from this Project.

Figure 7. GHG Emissions with and without Astoria Replacement Project



Source: Guidehouse Analysis; Arrows show reduction in GHG emissions with addition of Astoria Replacement Project.
Note: 2023 includes June – December 2023 only.

Figure 7 shows both the annual emissions with and without the Astoria Replacement Project and Table 3 summarizes the annual emission reduction from the addition of the Project to the electric system. The analysis shows an initial savings of 72,000 tons of direct CO_2 in 2023. The direct GHG emissions reduction from the Project trends downward as more renewable resources enter the system. However, as discussed in Section 3.2, indirect GHG emissions reductions from the Project rise significantly as the Project provides the capacity necessary to bring additional renewable resources on-line.

Over time, as overall system resources trend toward a zero-carbon emissions rate, the Astoria plant will operate at much lower capacity factors and serve primarily as a low-cost flexible resource to aid in system reliability and renewable integration. As the amount of renewables integration increases, the relative cost savings of capacity procured from the Astoria Replacement Project compared to equivalent capacity value procured from battery storage alone could be used to accelerate the construction of 543 MW of offshore wind resulting in an indirect GHG benefit of ~1M tons per year. For more detail, refer to Section 3.2.

Table 3. Annual Direct GHG Emissions Reduction with Astoria Replacement Project

Year	Emissions Reduction (000 Tons)	Cumulative Emissions Reduction (000 Tons)
2023	72	72
2024	88	161
2025	57	218
2026	38	256
2027	40	296
2028	18	314
2029	27	341
2030	21	362
2031	15	377
2032	19	396
2033	7	403
2034	13	416
2035	5	421

Source: Guidehouse Analysis. Note: 2023 includes June – December 2023 only.

3.2 Indirect GHG Reductions from the Astoria Replacement Project

This section discusses the challenges that will be faced by New York to complete full decarbonization as required by the CLCPA and the sizable indirect GHG emission reductions that can be realized from using the Astoria Replacement Project as a marginal capacity resource in the 2030's. At a high level, there will need to be sufficient in-city generation or transmission capability to maintain system reliability as renewable resources are added to the system. Geographic and technological diversity of renewable generation resources helps mitigate these challenges, but there will still be a need for dispatchable generation, such as the Astoria Replacement Project, to ensure that the balance is maintained.

Maintaining cost effective reliability is challenging due to the nature of the capacity reserve requirement whereby the marginal capacity resources on any system are largely needed for peak periods and emergency purposes and have relatively low capacity factors. In a system with fossil fuel generation, this role is often played by aging thermal units or combustion turbines that operate infrequently, but provide needed electricity during system contingencies and peak periods of demand. In a system with a significant share of energy storage providing this capacity, the marginal capacity resources will require longer duration capability to provide the same capacity value. The result is deration of the capacity value of battery storage, and BESS becomes significantly more expensive as you continue to grow the amount of BESS that is part of the system capacity mix. Keeping a small amount of gas generation on the system with a low capacity factor and low GHG emissions; has high capacity value and significantly lowers system cost. The savings from keeping this thermal generation rather than focusing on only batteries for capacity can be used to accelerate procurement of additional zero-carbon energy.

As described in Section 3.1.2, the Astoria Replacement Project is expected to have a low capacity factor after 2030 due to the expected addition of BESS and renewable resources to the system. With a 2.5% capacity factor, the direct emissions of the Project are ~21,000 tons per year. While a battery would not have these direct emissions, they would not be able to provide the same level of indirect GHG emission reductions that the Astoria Project can. If the savings from using the Astoria Replacement Project as capacity versus a battery are used to accelerate renewables, an additional 543 MW of offshore wind could be procured. Assuming a conservative 50% capacity factor, this results in ~2,400 GWh of generation per year from thermal resources that can be replaced with the additional wind. The GHG benefit of this is ~1,000,000 tons per year, which dwarfs the direct emissions from the Astoria Replacement Project.

3.2.1 The Role of the Astoria Replacement Project Post - 2040

One important implication of battery storage being de-rated as a capacity resource as penetration increases is that there needs to be technological advances over the next twenty years to fully decarbonize the power system in a cost-effective manner. It is not yet clear what technologies will emerge, but one key option includes converting natural gas generation to green hydrogen fuel. The turbine technology selected by the Astoria Replacement Project is capable of being converted to use hydrogen in the future instead of natural gas or fuel oil. This positions the Project to operate post 2040 within a zero-carbon electric grid (consistent with the CLCPA) while continuing to provide multiple benefits to the bulk power system.

Due to the lack of availability of green hydrogen fuel pricing and the unknown operational parameters of how the Astoria Project would dispatch by running on hydrogen, Guidehouse can only offer limited insights on the 2050 operation of the hydrogen-fired Project. Based on available data, Guidehouse projects that the annual average capacity factor for the Project operating on green hydrogen after 2040 would be ~1.3%, with a few starts in the shoulder months and a moderate amount of generation during the summer peak period in July 2050.

Appendix G

Class I Area AQRV Waiver Request

Stormwind, Brian

From:	Stormwind, Brian
Sent:	Friday, April 24, 2020 7:09 AM
To:	Catherine_Collins@fws.gov; rperron@fs.fed.us
Cc:	Konary, Shawn
Subject:	Request for Applicability of Class I Area Modeling Analysis
Attachments:	NRG Astoria PSD Permit Request for Determination 04-23-20.pdf

Dear Ms. Collins and Mr. Perron,

Astoria Gas Turbine Power LLC ("Astoria"), is proposing to modify its previously approved Astoria Turbine Replacement Project ("Replacement Project" or "Project") and replace 24 existing natural gas and liquid fuel fired combustion turbine generators ("CTG") at the Astoria Gas Turbine Generating Facility ("Astoria" or "Facility") with one new simple cycle CTG. Attached please find a Request for Applicability of Class I Area Modeling Analysis form for the proposed Project.

The Project, as previously configured and permitted in 2010, consisted of the replacement of the existing CTGs with 4 General Electric ("GE") 7F.04 CTGs and four steam turbine generators to create a combined cycle facility comprised of four 1x1 combined cycle units capable of generating 1,040 electrical megawatts ("MWe"). However, that project was not constructed at that time due to prevailing market conditions. The Facility currently consists of 31 older, peaking-only gas and oil-fired CTGs including 24 Pratt & Whitney ("P&W") turbines and seven previously retired Westinghouse turbines, with a combined nameplate rating of 646 MWe. The Project, as modified, will replace the 24 of the nearly 50-year-old P&W CTGs and the seven Westinghouse CTGs at the Facility with a new state-of-the-art simple cycle dual-fuel peaking CTG. The Project will replace all of these units with a new state-of-the-art simple cycle dual-fuel peaking CTG except for one P&W Twin Pac (consisting of two combustion turbines and a single generator). The two remaining P&W turbines will remain operational solely to make the site black-start capable.

The Project will include a new CTG which will be a highly efficient, fast-starting, GE H-Class 7HA.03 unit (or equivalent) that has a nominal generator output of approximately 437 MWe. The new CTG will fire natural gas as the primary fuel with limited firing of up to the equivalent of 720 hours per year ultra-low sulfur distillate ("ULSD") liquid fuel. The Project will also include a ULSD-fired emergency generator for safe shutdown and two ULSD-fired emergency fire system pumps. Astoria will submit an application to modify the Facility's Title V Air Permit to the New York Department of Environmental Conservation ("NYSDEC").

The closest Prevention of Significant Deterioration ("PSD") Class I area is the Brigantine National Wildlife Refuge approximately 150 km to the south of the Facility in southern New Jersey on the Atlantic Coast. Based on the Q/D screening criteria for sources located more than 50 km from the Class I areas, we believe that an Air Quality Related Values ("AQRV") analyses of this project is not necessary and we respectfully request your concurrence on that determination.

The Q in the Q/D is the sum of the short-term NO_x, SO_2, H_2SO_4, and PM emissions expressed in tons per year ("tpy"), and D is the distance in km from the project to the Class I area. The Project will result in a decrease in NO_x emissions and slight increases of SO_2 and H_2SO_4, all of which will be less than PSD significance thresholds given the use of low sulfur fuels (natural gas and ULSD). The value of Q is approximately 312 tpy based on $PM_{10}/PM_{2.5}$ emissions (maximum short-term emission rate of 71.10 lb/hr) and Q/D is 71.10 lb/hr x 8760 hrs/yr/2000 lb/ton = 312 tons per year (tpy)/150 km = 2.1, which is less than the FLAG screening threshold of 10. If all emissions were conservatively considered, NO_x (77.61 lb/hr), SO_2 (6.13 lb/hr), H_2SO_4 (4.04 lb/hr), and PM (71.10 lb/hr) the value of Q is approximately 696 tpy and Q/D is 696 tpy/150 km = 4.6.

Please review the material provided and let us know if you have any questions or require additional information. We look forward to your responses. Thank you for your consideration of the Project.

Best Regards,

Brian Stormwind

Request for Applicability of Class I Area Modeling Analysis
U.S. Fish & Wildlife Service, U.S. Forest Service

Facility Name (Company Name)	Astoria Gas Turbine Power LLC
New Facility or Modification?	Modification
Source Type	Simple-cycle Combustion Turbine
Project Location (County/State/ Lat. & Long. in decimal degrees)	Astoria, Queens County, NY / 40.79 N & 73.91 W

Application Contacts

Applicant		*Consultant*		*Air Agency Permit Engineer*	
Company	Astoria Gas Turbine Power LLC	**Company**	AECOM	**Agency**	New York DEC
Contact	Shawn Konary	**Contact**	Brian Stormwind	**Contact**	Chris Hogan
Address	31-01 20th Ave Astoria, NY 11105	**Address**	250 Apollo Drive Chelmsford, MA 01824	**Address**	625 Broadway Albany, New York
Phone #	617-529-3874	**Phone #**	978-905-2413	**Phone #**	518-402-9251
Email	Shawn.Konary@nrg.com	**Email**	Brian.Stormwind@aecom.com	**Email**	Chris.Hogan@dec.ny.gov

Briefly Describe the Proposed Project

Astoria Gas Turbine Power LLC ("Astoria") is proposing to replace 24 existing natural gas and liquid fuel fired combustion turbine generators ("CTG") at the Astoria Gas Turbine Generating Facility ("Facility") with one new simple cycle CTG (approximately 437 MW). The new CTG will fire natural gas as the primary fuel with limited firing of the equivalent of 720 hours per year of ultra-low sulfur distillate liquid fuel ("ULSD"). The Project will also include a ULSD-fired emergency generator, and two ULSD-fired emergency fire system pumps and retain two existing CTGs solely to maintain black-start capability for the site. The Project will be a modification of the existing Facility, which is classified as a major source under both the Prevention of Significant Deterioration ("PSD") and Non-Attainment New Source Review ("NNSR") air permitting programs. The Project will be a major PSD modification for particulate matter with diameters less than 10 microns ("PM_{10}")/particulate matter with diameters less than 2.5 microns ("$PM_{2.5}$") and greenhouse gases ("GHG").

Proposed Emissions and BACT

Criteria Pollutant	***Proposed Emissions tons/year (max lb/hr from the new CTG)***	***Emission Factor (AP-42, Stack Test, Other?)***	***Proposed BACT***
Nitrogen Oxides	96.60	Vendor Design	N/A
Sulfur Dioxide	7.90	Engineering Estimate	N/A
Particulate Matter	52.47	Vendor Design	Natural Gas: 0.0082 lb/MMBtu heat input, not to exceed 23.2 lb/hr; ULSD: 0.025 lb/MMBtu heat input not to exceed 71.1 lb/hr.

Volatile Organic Compounds	24.82	Vendor Design	N/A
Sulfuric Acid Mist	5.20	Engineering Estimate	N/A

Proximity to Class I Areas

Class I Area	Bringatine Wilderness	Lye Brook	
Distance from Facility (km)	150 km	260 km	

Appendix H

Federal Aviation Administration Notification

Federal Aviation Administration

« OE/AAA

Notice of Proposed Construction or Alteration - Off Airport

Add a New Case (Off Airport) - Desk Reference Guide V_2018.2.1

Add a New Case (Off Airport) for Wind Turbines - Met Towers (with WT Farm) - WT-Barge Crane - Desk Reference Guide V_2018.2.1

Project Name: ASTOR-000575215-20 **Sponsor:** Astoria Gas Turbine Power LLC

Details for Case : CTG Stack

Show Project Summary

Case Status

ASN:	2020-AEA-4878-OE	**Date Accepted:**	04/25/2020
Status:	Accepted	**Date Determined:**	
		Letters:	None
		Documents:	None
Public Comments:	None		Project Documents: None

Construction / Alteration Information

Notice Of:	Construction
Duration:	Permanent
if Temporary :	Months: Days:
Work Schedule - Start:	08/02/2021
Work Schedule - End:	07/29/2022

****For temporary cranes-Does the permanent structure require separate notice to the FAA? To find out, use the Notice Criteria Tool. If separate notice is required, please ensure it is filed. If it is not filed, please state the reason in the Description of Proposal.***

State Filing:	Not filed with State

Structure Summary

Structure Type:	Stack
Structure Name:	CTG Stack
FDC NOTAM:	
NOTAM Number:	
FCC Number:	
Prior ASN:	2012-AEA-3544-OE

Structure Details

Latitude:	40° 47' 18.20" N
Longitude:	73° 54' 22.20" W
Horizontal Datum:	NAD83
Site Elevation (SE):	19 (nearest foot) PASSED
Structure Height (AGL):	250 (nearest foot)
Current Height (AGL): ** For notice of alteration or existing provide the current AGL height of the existing structure. Include details in the Description of Proposal*	(nearest foot)
Minimum Operating Height (AGL): ** For aeronautical study of a crane or construction equipment the maximum height should be listed above as the Structure Height (AGL). Additionally, provide the minimum operating height to avoid delays if impacts are identified that require negotiation to a reduced height. If the Structure Height and minimum operating height are the same enter the same value in both fields.*	(nearest foot)
Requested Marking/Lighting:	Dual-red and medium intensity
Other :	
Recommended Marking/Lighting:	
Current Marking/Lighting:	N/A Proposed Structure
Other :	
Nearest City:	New York City
Nearest State:	New York
Description of Location: *On the Project Summary page upload any certified survey.*	Approximately 1.5 miles northwest of LaGuardia Airport.
Description of Proposal:	Astoria Gas Turbine Power LLC ("Astoria") is proposing to replace existing combustion turbines with a new simple cycle turbine with a new 250'emissions stack. The Astoria Facility is located on a 15-acre site within an existing industrial complex.

Proposed Frequency Bands

Select any combination of the applicable frequencies/powers identified in the Colo Void Clause Coalition, Antenna System Co-Location, Voluntary Best Practices, effective 21 Nov 2007, to be evaluated by the FAA with your filing. If not within one of the frequency bands listed below, manually input your proposed frequency(ies) and power using the Add Specific Frequency link.

Add Specific Frequency

Low Freq	High Freq	Freq Unit	ERP	ERP Unit

Previous Back to Search Result Next

Appendix I

Supporting GHG Information

Astoria Replacement Project
Project Maximum Annual GHG Emissions

CTG	SS NG	NG SU/SD	SS ULSD	ULSD SU/SD	Total
CO2	441,382	24,355	234,045	12,377	712,160
CH4	8	0	10	1	18.77
N2O	1	0	2	0	2.88
CO2e based on Part 496 20-yr GWP	442,299	24,405	235,347	12,446	714,497

Emergency Engines	EG	FP#1	FP#2
Heat Input (MMBtu/hr)	5.00	1.17	1.78
Hours/year	500	500	500
CO2	204	48	73
CH4	0.0083	0.0019	0.0029
N2O	0.0017	0.0004	0.0006
CO2e based on Part 496 20-yr GWP	205	48	73

Fugitives	
CH4	107.56
SF6	0.00083
CO2e based on Part 496 20-yr GWP	9,050

Project Total Direct Emissions	**CTG**	**EG**	**FP#1**	**FP#2**	**Fugitives**	**Total**
CO2	712,160	204	48	73	0	712,484
CH4	18.77	0.008	0.002	0.003	107.56	126.34
N2O	2.88	0.0017	0.0004	0.0006	0	2.88
SF6	-	-	-	-	0.00083	0.00083
CO2e based GWP20	714,497	205	48	73	9,050	723,872

Project Fuel Use	
Natural Gas MMBtu/yr	7,939,520
Diesel MMBtu/yr	3,033,631

Project Upstream Fuel Emission Factors	CO2 lb/MMBtu	CH4 lb/MMBtu	N2O lb/MMBtu	CO2e lb/MMBtu GWP20
Natural Gas	24.82	0.36	0.00030	54.88
Diesel	24.02	0.26	0.00049	45.63

Total Project Upstream Fuel Emissions	CO2 tons/yr	CH4 tons/yr	N2O tons/yr	CO2e lb/MMBtu GWP20
Natural Gas	98,531	1,417	1.18	217,880
Diesel	36,438	388	0.75	69,219
Total	134,969	1,805	1.93	287,099

6 NYCRR §496.5	**CO2**	**CH4**	**N2O**	**SF6**
Part 496 GWP20	1	84	264	17,500

Astoria Replacement Project
Project Estimated/Expected Future Annual Emissions

		Estimated Future Annual Totals	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
2023-2035 Avg.	**4.4%**	Capacity Factor	19.5%	10.6%	7.6%	5.0%	5.0%	2.4%	3.3%	2.5%	1.9%	2.4%	1.0%	1.8%	0.5%	1.4%	0.9%	1.1%	0.8%
2023-2035 Total Pot. GWh	47,080	Potential Generation (GWh)	2,188	3,749	3,738	3,738	3,738	3,749	3,738	3,738	3,738	3,749	3,738	3,738	3,738	3,749	3,738	3,738	3,738
2023-2035 Total GWh	2,075	Total Generation (GWh)	427	397	283	185	188	91	123	95	72	89	37	69	18	52	33	40	30
		Turbine Startups	14	40	27	18	18	11	14	12	9	7	5	6	5	5	4	4	5
		Turbine Hours of Operation	1,328	1,136	821	535	520	254	352	271	201	265	104	206	43	157	90	115	80
		Turbine Fuel Used (MMBtu)	4,107,153	3,763,258	2,700,482	1,768,396	1,775,619	864,548	1,176,780	904,826	682,199	856,182	353,432	662,250	168,268	500,708	312,055	379,231	279,308
		Turbine CO2 Emission (metric tons)	221,694	203,131	145,765	95,454	95,844	46,666	63,520	48,840	36,823	46,215	19,077	35,747	9,083	27,027	16,844	20,470	15,076
		Emergency Engine Hours (hr/yr/engine) @ 1 hr/week	30	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52
Turbine SU/SD Emission Factors			**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**
Total MMBtu/SU+SD	1,951	Turbine SU/SD Totals: MMBtu from SU/SD	27,314	78,040	52,677	35,118	35,118	21,461	27,314	23,412	17,559	13,657	9,755	11,706	9,755	9,755	7,804	7,804	9,755
NOx lb/SU+SD	253	NOx SU/SD (tons)	1.8	5.1	3.4	2.3	2.3	1.4	1.8	1.5	1.1	0.9	0.6	0.8	0.6	0.6	0.5	0.5	0.6
CO lb/SU+SD	240	CO SU/SD (tons)	1.7	4.8	3.2	2.2	2.2	1.3	1.7	1.4	1.1	0.8	0.6	0.7	0.6	0.6	0.5	0.5	0.6
VOC lb/SU+SD	72	VOC SU/SD (tons)	0.5	1.4	1.0	0.6	0.6	0.4	0.5	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.1	0.1	0.2
PM lb/SU+SD	15.7	PM SU/SD (tons)	0.1	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SO2 lb/SU+SD	3.20	SO2 SU/SD (tons)	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
H2SO4 lb/SU+SD	2.10	H2SO4 SU/SD (tons)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CH4 lb/SU+SD	5.02	CH4 SU/SD (tons)	0.04	0.10	0.07	0.05	0.05	0.03	0.04	0.03	0.02	0.02	0.01	0.02	0.01	0.01	0.01	0.01	0.01
N2O lb/SU+SD	0.50	N2O SU/SD (tons)	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Turbine Steady-State Emission Factors		Turbine Steady-State Emissions	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**
		MMBtu	4,079,839	3,685,218	2,647,805	1,733,278	1,740,501	843,087	1,149,466	881,414	664,640	842,525	343,677	650,544	158,513	490,953	304,251	371,427	269,553
NOx lb/MMBtu	0.00920	NOx (tons)	18.8	17.0	12.2	8.0	8.0	3.9	5.3	4.1	3.1	3.9	1.6	3.0	0.7	2.3	1.4	1.7	1.2
CO lb/MMBtu	0.00784	CO (tons)	16.0	14.4	10.4	6.8	6.8	3.3	4.5	3.5	2.6	3.3	1.3	2.6	0.6	1.9	1.2	1.5	1.1
VOC lb/MMBtu	0.00256	VOC (tons)	5.2	4.7	3.4	2.2	2.2	1.1	1.5	1.1	0.9	1.1	0.4	0.8	0.2	0.6	0.4	0.5	0.3
PM lb/MMBtu	0.0073	PM (tons)	14.9	13.5	9.7	6.3	6.4	3.1	4.2	3.2	2.4	3.1	1.3	2.4	0.6	1.8	1.1	1.4	1.0
SO2 lb/MMBtu	0.00140	SO2 (tons)	2.9	2.6	1.9	1.2	1.2	0.6	0.8	0.6	0.5	0.6	0.2	0.5	0.1	0.3	0.2	0.3	0.2
H2SO2 lb/MMBtu	0.00092	H2SO4 (tons)	1.9	1.7	1.2	0.8	0.8	0.4	0.5	0.4	0.3	0.4	0.2	0.3	0.1	0.2	0.1	0.2	0.1
CH4 lb/MMBtu	0.00220	CH4 (tons)	4.50	4.06	2.92	1.91	1.92	0.93	1.27	0.97	0.73	0.93	0.38	0.72	0.17	0.54	0.34	0.41	0.30
N2O lb/MMBtu	0.00022	N2O (tons)	0.45	0.41	0.29	0.19	0.19	0.09	0.13	0.10	0.07	0.09	0.04	0.07	0.02	0.05	0.03	0.04	0.03
CTG	**2023-35 Avg**	Total Annual Turbine Emissions: tons/year	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**
	8.7	NOx	20.5	22.0	15.6	10.3	10.3	5.3	7.1	5.6	4.2	4.8	2.2	3.8	1.4	2.9	1.9	2.2	1.9
	7.6	CO	17.7	19.2	13.6	9.0	9.0	4.6	6.2	4.9	3.7	4.1	1.9	3.3	1.2	2.5	1.7	1.9	1.7
	2.4	VOC	5.7	6.2	4.4	2.9	2.9	1.5	2.0	1.6	1.2	1.3	0.6	1.0	0.4	0.8	0.5	0.6	0.5
	5.6	PM	15.0	13.8	9.9	6.5	6.5	3.2	4.3	3.3	2.5	3.1	1.3	2.4	0.6	1.8	1.1	1.4	1.0
	1.1	SO2	2.9	2.7	1.9	1.2	1.3	0.6	0.8	0.6	0.5	0.6	0.2	0.5	0.1	0.4	0.2	0.3	0.2
	0.7	H2SO4	1.9	1.7	1.3	0.8	0.8	0.4	0.5	0.4	0.3	0.4	0.2	0.3	0.1	0.2	0.1	0.2	0.1
	90,547	CO2	244,376	223,914	160,679	105,220	105,649	51,441	70,018	53,837	40,591	50,943	21,029	39,404	10,012	29,792	18,567	22,564	16,619
	1.68	CH4	4.53	4.16	2.99	1.96	1.96	0.96	1.30	1.00	0.76	0.95	0.39	0.73	0.19	0.55	0.35	0.42	0.31
	0.17	N2O	0.45	0.42	0.30	0.20	0.20	0.10	0.13	0.10	0.08	0.09	0.04	0.07	0.02	0.06	0.03	0.04	0.03
	90,733	CO2e Part 496 GWP20	244,876	224,373	161,008	105,435	105,866	51,546	70,162	53,948	40,674	51,047	21,072	39,485	10,033	29,853	18,605	22,611	16,653
Emergency Generator	**2023-35 Avg**	Em. Generator Engine Emissions: tons/year	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**
		Heat Input (MMBtu)	149.85	259.74	259.74	259.74	259.74	259.74	259.74	259.74	259.74	259.74	259.74	259.74	259.74	259.74	259.74	259.74	259.74
	0.021	NOx	0.012	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021
	0.108	CO	0.064	0.111	0.111	0.111	0.111	0.111	0.111	0.111	0.111	0.111	0.111	0.111	0.111	0.111	0.111	0.111	0.111
	0.006	VOC	0.003	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006
	0.0009	PM	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	0.0002	SO2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.00003	H2SO4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	20.5	CO2	12.217	21.176	21.176	21.176	21.176	21.176	21.176	21.176	21.176	21.176	21.176	21.176	21.176	21.176	21.176	21.176	21.176
	0.001	CH4	0.0005	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009
	0.00017	N2O	0.0001	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
	20.6	CO2e Part 496 GWP20	12.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3

Astoria Replacement Project
Project Estimated/Expected Future Annual Emissions

		Estimated Future Annual Totals	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
2023-2035 Avg.	**4.4%**	Capacity Factor	19.5%	10.6%	7.6%	5.0%	5.0%	2.4%	3.3%	2.5%	1.9%	2.4%	1.0%	1.8%	0.5%	1.4%	0.9%	1.1%	0.8%
2023-2035 Total Pot. GWh	47,080	Potential Generation (GWh)	2,188	3,749	3,738	3,738	3,738	3,749	3,738	3,738	3,738	3,749	3,738	3,738	3,738	3,749	3,738	3,738	3,738
2023-2035 Total GWh	2,075	Total Generation (GWh)	427	397	283	185	188	91	123	95	72	89	37	69	18	52	33	40	30
		Turbine Startups	14	40	27	18	18	11	14	12	9	7	5	6	5	5	4	4	5
		Turbine Hours of Operation	1,328	1,136	821	535	520	254	352	271	201	265	104	206	43	157	90	115	80
		Turbine Fuel Used (MMBtu)	4,107,153	3,763,258	2,700,482	1,768,396	1,775,619	864,548	1,176,780	904,826	682,199	856,182	353,432	662,250	168,268	500,708	312,055	379,231	279,308
		Turbine CO2 Emission (metric tons)	221,694	203,131	145,765	95,454	95,844	46,666	63,520	48,840	36,823	46,215	19,077	35,747	9,083	27,027	16,844	20,470	15,076
		Emergency Engine Hours (hr/yr/engine) @ 1 hr/week	30	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52
Fire Pump #1	**2023-35 Avg**	Em. Fire System Pump Engine #1: tons/year	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**
		Heat Input (MMBtu)	35.24	61.07	61.07	61.07	61.07	61.07	61.07	61.07	61.07	61.07	61.07	61.07	61.07	61.07	61.07	61.07	61.07
	0.026	NOx	0.015	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027
	0.032	CO	0.019	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033
	0.001	VOC	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	0.002	PM	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
	0.00004	SO2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.00001	H2SO4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4.82	CO2	2.873	4.979	4.979	4.979	4.979	4.979	4.979	4.979	4.979	4.979	4.979	4.979	4.979	4.979	4.979	4.979	4.979
	0.0002	CH4	0.0001	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
	0.00004	N2O	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	4.8	CO2e Part 496 GWP20	2.9	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Fire Pump #2	**2023-35 Avg**	Em. Fire System Pump Engine #2: tons/year	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**
		Heat Input (MMBtu)	53.46	92.66	92.66	92.66	92.66	92.66	92.66	92.66	92.66	92.66	92.66	92.66	92.66	92.66	92.66	92.66	92.66
	0.039	NOx	0.023	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041
	0.034	CO	0.020	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035
	0.0012	VOC	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	0.002	PM	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
	0.0001	SO2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.00001	H2SO4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	7.3	CO2	4.358	7.555	7.555	7.555	7.555	7.555	7.555	7.555	7.555	7.555	7.555	7.555	7.555	7.555	7.555	7.555	7.555
	0.0003	CH4	0.0002	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
	0.00006	N2O	0.0000	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
	7.3	CO2e Part 496 GWP20	4.4	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Project Total	**2023-35 Avg**	Total Facility Expected Emissions: tons/year	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**
	8.77	NOx	20.60	22.11	15.69	10.34	10.38	5.36	7.15	5.66	4.29	4.85	2.30	3.84	1.45	2.98	1.99	2.30	1.96
	7.75	CO	17.78	19.43	13.80	9.14	9.16	4.81	6.37	5.08	3.87	4.32	2.13	3.45	1.40	2.71	1.85	2.12	1.84
	2.93	VOC	6.23	6.66	4.87	3.37	3.38	1.98	2.48	2.07	1.68	1.84	1.13	1.56	0.89	1.31	1.04	1.13	1.03
	5.57	PM	15.00	13.77	9.88	6.47	6.50	3.17	4.31	3.32	2.50	3.14	1.30	2.43	0.62	1.84	1.15	1.39	1.03
	1.07	SO2	2.89	2.65	1.90	1.25	1.25	0.61	0.83	0.64	0.48	0.60	0.25	0.47	0.12	0.35	0.22	0.27	0.20
	0.7	H2SO4	1.90	1.75	1.25	0.82	0.82	0.40	0.55	0.42	0.32	0.40	0.16	0.31	0.08	0.23	0.14	0.18	0.13
	90,580	CO2	244,395	223,948	160,712	105,253	105,683	51,474	70,052	53,871	40,625	50,977	21,063	39,438	10,046	29825.84	18600.97	22597.96	16652.53
	1.68	CH4	4.53	4.16	2.99	1.96	1.97	0.96	1.30	1.00	0.76	0.95	0.39	0.73	0.19	0.56	0.35	0.42	0.31
	0.169	N2O	0.45	0.42	0.30	0.20	0.20	0.10	0.13	0.10	0.08	0.09	0.04	0.07	0.02	0.06	0.03	0.04	0.03
	0.0000	SF6	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	90,766	CO2e Part 496 GWP20	244,896	224,407	161,042	105,469	105,900	51,580	70,196	53,982	40,708	51,081	21,106	39,519	10,067	29,887	18,639	22,644	16,687

Astoria Replacement Project
Project Estimated/Expected Future Annual Emissions

		Estimated Future Annual Totals	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
2023-2035 Avg.	**4.4%**	Capacity Factor	19.5%	10.6%	7.6%	5.0%	5.0%	2.4%	3.3%	2.5%	1.9%	2.4%	1.0%	1.8%	0.5%	1.4%	0.9%	1.1%	0.8%
2023-2035 Total Pot. GWh	47,080	Potential Generation (GWh)	2,188	3,749	3,738	3,738	3,738	3,749	3,738	3,738	3,738	3,749	3,738	3,738	3,738	3,749	3,738	3,738	3,738
2023-2035 Total GWh	2,075	Total Generation (GWh)	427	397	283	185	188	91	123	95	72	89	37	69	18	52	33	40	30
		Turbine Startups	14	40	27	18	18	11	14	12	9	7	5	6	5	5	4	4	5
		Turbine Hours of Operation	1,328	1,136	821	535	520	254	352	271	201	265	104	206	43	157	90	115	80
		Turbine Fuel Used (MMBtu)	4,107,153	3,763,258	2,700,482	1,768,396	1,775,619	864,548	1,176,780	904,826	682,199	856,182	353,432	662,250	168,268	500,708	312,055	379,231	279,308
		Turbine CO_2 Emission (metric tons)	221,694	203,131	145,765	95,454	95,844	46,666	63,520	48,840	36,823	46,215	19,077	35,747	9,083	27,027	16,844	20,470	15,076
		Emergency Engine Hours (hr/yr/engine) @ 1 hr/week	30	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52

		Project Upstream NG Emissions: tons/year	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Project Upstream GHG from Natural Gas	lb/MMBtu	Natural Gas MMBtu/yr	4,107,153	3,763,258	2,700,482	1,768,396	1,775,619	864,548	1,176,780	904,826	682,199	856,182	353,432	662,250	168,268	500,708	312,055	379,231	279,308
	24.820	CO_2 Upstream GHG from Natual Gas	50,971	46,703	33,513	21,946	22,036	10,729	14,604	11,229	8,466	10,625	4,386	8,219	2,088	6,214	3,873	4,706	3,466
	0.3570	CH_4 Upstream GHG from Natual Gas	733	672	482	316	317	154	210	161	122	153	63	118	30	89	56	68	50
	0.0003	N_2O Upstream GHG from Natual Gas	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	54.88	CO_2e GWP20 Upstream GHG from Natual Gas	112,710	103,273	74,108	48,529	48,727	23,725	32,294	24,831	18,721	23,496	9,699	18,174	4,618	13,741	8,564	10,407	7,665

		Project Upstream Diesel Emissions: tons/year	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Project Upstream GHG from Diesel	lb/MMBtu	Diesel MMBtu/yr	238.55	413.48	413.48	413.48	413.48	413.48	413.48	413.48	413.48	413.48	413.48	413.48	413.48	413.48	413.48	413.48	413.48
	24.02	CO_2 Upstream GHG from Diesel	2.87	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97
	0.26	CH_4 Upstream GHG from Diesel	0.03	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	0.00	N_2O Upstream GHG from Diesel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	45.63	CO_2e GWP20 Upstream GHG from Diesel	5.44	9.43	9.43	9.43	9.43	9.43	9.43	9.43	9.43	9.43	9.43	9.43	9.43	9.43	9.43	9.43	9.43

Upstream GHG Emissions from Extraction and Transmission of Project Fuel			2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
2023-2039 Avg tons CO_2	**18,891**	Total Project Upstream CO_2	50,973	46,708	33,518	21,951	22,041	10,734	14,609	11,234	8,471	10,630	4,391	8,224	2,093	6,219	3,878	4,711	3,471
2023-2039 Avg tons CH_4	**272**	Total Project Upstream CH_4	733	672	482	316	317	154	210	162	122	153	63	118	30	89	56	68	50
2023-2039 Avg tons N_2O	**0.227**	Total Project Upstream N_2O	0.61	0.56	0.40	0.26	0.26	0.13	0.18	0.14	0.10	0.13	0.05	0.10	0.03	0.07	0.05	0.06	0.04
2023-2039 Avg tons CO_2e	**41,771**	CO_2e GWP20 Total Project Upstream Emissions	112,716	103,282	74,117	48,538	48,737	23,735	32,303	24,840	18,731	23,505	9,708	18,183	4,627	13,750	8,573	10,416	7,674

Upstream GHG Emissions from Extraction and Transmission of Displaced Unit Fuel			2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
2023-35 Avg (tons)	lb/MMBtu	Displaced Units heat input, MMBtu	5,277,931	5,209,686	3,591,586	2,386,406	2,432,913	1,155,775	1,613,304	1,234,309	929,190	1,161,339	448,742	872,594	246,962	522,766	522,766	522,766	522,766
25,356	24.820	CO_2 Upstream GHG from Natual Gas	65,500	64,653	44,572	29,616	30,193	14,343	20,021	15,318	11,531	14,412	5,569	10,829	3,065	6,488	6,488	6,488	6,488
365	0.3570	CH_4 Upstream GHG from Natual Gas	942	930	641	426	434	206	288	220	166	207	80	156	44	93	93	93	93
0.305	0.0003	N_2O Upstream GHG from Natual Gas	0.79	0.78	0.54	0.36	0.36	0.17	0.24	0.18	0.14	0.17	0.07	0.13	0.04	0.08	0.08	0.08	0.08
56,069	54.885	CO_2e GWP20 Upstream GHG from Natual Gas	144,839	142,966	98,562	65,489	66,765	31,717	44,273	33,872	25,499	31,870	12,315	23,946	6,777	14,346	14,346	14,346	14,346

Used natural gas upstream emission factors for displaced units

Upstream GHG Emissions Difference from Displaced Units Due to Project			2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
2023-2039 Avg tons CO_2	**6,465**	CO_2 Upstream GHG from Natual Gas	14,527	17,945	11,054	7,665	8,152	3,609	5,412	4,084	3,060	3,782	1,178	2,605	972	269	2,610	1,776	3,016
2023-2039 Avg tons CH_4	**93**	CH_4 Upstream GHG from Natual Gas	209	258	159	110	117	52	78	59	44	54	17	37	14	4	38	26	43
2023-2039 Avg tons N_2O	**0.078**	N_2O Upstream GHG from Natual Gas	0.17	0.22	0.13	0.09	0.10	0.04	0.06	0.05	0.04	0.05	0.01	0.03	0.01	0.00	0.03	0.02	0.04
2023-2039 Avg tons CO_2e	**14,298**	CO_2e GWP20 Upstream GHG from Natual Gas	32,124	39,684	24,445	16,950	18,028	7,983	11,970	9,032	6,769	8,365	2,606	5,763	2,150	596	5,773	3,930	6,672

6 NYCRR §496.5	**CO_2**	**CH_4**	**N_2O**
Part 496 GWP20	1	84	264

Astoria Replacement Project
Upstream Natural Gas factors

	Exhibit F-1		Exhibit F-31						
kg/MJ	Appalachian Shale Production	Gathering / Boosting	Processing	Transmission Station	Storage	Transmission Pipeline	Distribution	Total	CO2e (Part 496 GWP20)
CO2	1.36E-03	3.36E-03	1.33E-03	4.61E-03	4.41E-07	1.40E-07	1.02E-05	1.07E-02	0.0236
CH4	2.10E-05	4.56E-05	1.38E-05	3.62E-05	1.56E-06	6.71E-06	2.86E-05	1.53E-04	
N2O	2.46E-09	4.58E-12	4.73E-09	1.21E-07	3.06E-13	0.00E+00	0.00E+00	1.28E-07	

Upstream GHG from Natural Gas based on Exhibit F-1 Appalachian-Shale Production, gathering & boosting and Exhibit F-31 for processing, Transmission station, storage & pipeline, and distribution from NETL Report "Life Cycle Analysis of Natural Gas Extraction and Power Generation" (DOE/NETL-2019/2039). All values are on a higher heating value (HHV) basis.

lb/MMBtu	Appalachian Shale Production	Gathering / Boosting	Processing	Transmission Station	Storage	Transmission Pipeline	Distribution	Total	CO2e (Part 496 GWP20)
CO2	3.1634	7.8154	3.0936	10.7229	0.0010	0.0003	0.0237	24.8204	**54.885**
CH4	0.0488	0.1061	0.0321	0.0842	0.0036	0.0156	0.0665	0.3570	
N2O	0.0000	0.0000	0.0000	0.0003	0.0000	0.0000	0.0000	0.0003	

Factors converted from kg/MJ to lb/MMBtu lb/MMBtu = kg/MJ *1000 g/kg * (1.055056 kJ/Btu / 1000 kJ/MJ)*1000000 Btu/MMBtu / 453.59 g/lb

Upstream Petroleum factors

Diesel		Kerosene (Jet Fuel)	
21	g CO2e/MJ (LHV)	18	g CO2e/MJ (LHV)
18,315	diesel LHV (Btu/lb)	18,487	kerosene LHV (Btu/lb)
19,604	diesel HHV (Btu/lb)	19,862	kerosene HHV (Btu/lb)
19.62	g CO2e/MJ (HHV)	16.75	g CO2e/MJ (HHV)
45.63	lb CO2e/MMBtu(HHV) - Non-Part 496 20-yr GWPs	38.97	lb CO2e/MMBtu(HHV) - Non-Part 496 20-yr GWPs
24.02	lb CO2/MMBtu(HHV)	20.51	lb CO2/MMBtu(HHV)
0.26	lb CH4/MMBtu(HHV)	0.22	lb CH4/MMBtu(HHV)
0.0005	lb N2O/MMBtu(HHV)	0.0004	lb N2O/MMBtu(HHV)
45.63	**lb CO2e/MMBtu(HHV) - 20-yr GWPs**	**38.97**	**lb CO2e/MMBtu(HHV) - 20-yr GWPs**

Upstream GHG from Diesel and Kerosene (Jet) based on Well-to-Tank PADD1 Table SI-45 (20-year GWP) from Supporting Information from Environmental Science & Technology 2017, 51, 2, 977-981
"Updating the U.S. Life Cycle GHG Petroleum Baseline to 2014 with Projections to 2040 Using Open-Source Engineering-Based Models"
https://pubs.acs.org/doi/suppl/10.1021/acs.est.6b02819/suppl_file/es6b02819_si_001.pdf
Emission factors provided in the reference document are on a lower heating value basis (LHV).
LHV and HHV basis estimated using values from Engineering Toolbox https://www.engineeringtoolbox.com/fuels-higher-calorific-values-d_169.html
Factors converted from LHV basis to HHV basis g/MJ (HHV) = g/MJ (LHV) * LHV (Btu/lb) / HHV (Btu/lb)
Factors converted from g/MJ to lb/MMBtu lb/MMBtu = g/MJ * (1.055056 kJ/Btu / 1000 kJ/MJ)*1000000 Btu/MMBtu / 453.59 g/lb
CO2e based on GWPs which are slightly higher than Part 496. Values presented are not adjusted for this discrepancy.

Individual GHG components (CO2, CH4, N2O) are calculated based on fractional contribution to CO2e and Part 496 GWP20, based on below
lb CO2/MMBtu (HHV) = lb CO2e/MMBtu (HHV) * 0.5264 / 1
lb CH4/MMBtu (HHV) = lb CO2e/MMBtu (HHV) * 0.47074 / 84
lb N2O/MMBtu (HHV) = lb CO2e/MMBtu (HHV) * 0.00285 / 264

Individual GHG Fractions are based on values from Table 35 of ICF Analysis of heating oil for New York/New Jersey/Pennsylvania
https://noraweb.org/wp-content/uploads/2016/11/GHG-Resource-Analysis-for-residential-Boilers-Final-Report-9-7-08-2.pdf
That analysis used GWPs of 23 for CH4 and 296 for N2O. These values are used to derive individual species from the values presented in Table 35.

Values from Table 35 *as CO2e*		GHGs as Individual Species		GHGs as Part 496 GWP20		Individual GHG Fraction from CO2e	
24.75	lb CO2/MMBtu as CO2e	24.75	lb CO2/MMBtu	24.75	lb CO2e/MMBtu	0.52642	CO2 fraction of CO2e
6.06	lb CH4/MMBtu as CO2e	0.2635	lb CH4/MMBtu	22.132	lb CO2e/MMBtu	0.47074	CH4 fraction of CO2e
0.15	lb N2O/MMBtu as CO2e	0.00051	lb N2O/MMBtu	0.1338	lb COe/MMBtu	0.00285	N2O fraction of CO2e

Astoria Replacement Project
GHG Emissions Reductions and Value of Carbon

Direct, Indirect, and Upstream GHG Emissions Reductions Caused by the Project (000 tons)

	Direct CO_2	Direct CH_4	Direct N_2O	Total Direct GHG CO_2e	Indirect GHG	Upstream CO_2	Upstream CH_4	Upstream N_2O	Total Upstream GHG CO_2e	Dir. + Indir. + Upst. GHG CO_2e	Cumulative GHG CO_2e			
											Direct GHG	Indirect GHG	Upstream GHG	Total
2023	72.09	0.0013	0.00013	**72**	**0**	14.5	0.21	0.00017	**32**	104	72	0	32	**104**
2024	88.05	0.0016	0.00016	**88**	**0**	17.9	0.26	0.00022	**40**	128	160	0	72	**232**
2025	57.03	0.0010	0.00010	**57**	**0**	11.1	0.16	0.00013	**24**	82	218	0	96	**314**
2026	38.14	0.0007	0.00007	**38**	**0**	7.7	0.11	0.00009	**17**	55	256	0	113	**369**
2027	40.04	0.0007	0.00007	**40**	**0**	8.2	0.12	0.00010	**18**	58	296	0	131	**427**
2028	18.05	0.0003	0.00003	**18**	**0**	3.6	0.05	0.00004	**8**	26	314	0	139	**453**
2029	26.98	0.0005	0.00005	**27**	**0**	5.4	0.08	0.00006	**12**	39	341	0	151	**492**
2030	21.00	0.0004	0.00004	**21**	**476**	4.1	0.06	0.00005	**9**	506	362	476	160	**998**
2031	15.05	0.0003	0.00003	**15**	**646**	3.1	0.04	0.00004	**7**	668	377	1,122	167	**1,666**
2032	18.96	0.0003	0.00003	**19**	**782**	3.8	0.05	0.00005	**8**	809	396	1,904	175	**2,476**
2033	7.10	0.0001	0.00001	**7**	**979**	1.2	0.02	0.00001	**3**	989	403	2,883	178	**3,464**
2034	13.08	0.0002	0.00002	**13**	**961**	2.6	0.04	0.00003	**6**	980	416	3,844	184	**4,444**
2035	4.98	0.0001	0.00001	**5**	**990**	1.0	0.01	0.00001	**2**	997	**421**	**4,834**	**186**	**5,441**
2036	*8.39*	*0.0000*	*0.00000*	*8*	*977*	*0.3*	*0.00*	*0.00000*	*1*	*986*	430	5,811	186	*6,427*
2037	*8.39*	*0.0002*	*0.00002*	*8*	*977*	*2.6*	*0.04*	*0.00003*	*6*	*991*	438	6,787	192	*7,418*
2038	*8.39*	*0.0002*	*0.00002*	*8*	*977*	*1.8*	*0.03*	*0.00002*	*4*	*989*	447	7,764	196	*8,407*
2039	*8.39*	*0.0003*	*0.00003*	*8*	*977*	*3.0*	*0.04*	*0.00004*	*7*	*992*	455	8,741	203	*9,398*
2040														

The average of 2033-2035 is used for years 2036-2039 based on similar estimated Project capacity factor.
2036-2039 upstream emissions are based on 2033-2035 average for displaced uints and calculations for the Project.

CO2 Emissions Reduction Benefits from Displaced Units (000 mt)

	CO2 Direct	CO2 Imp. Elec.	CO2 Indirect	CO2 Upstream	CO2 Year Total	CO2 Cumulative
2023	65	0.08	0	13.2	78.6	79
2024	80	0.05	0	16.3	96.2	175
2025	52	0.03	0	10.0	61.8	236
2026	34	0.13	0	7.0	41.6	278
2027	36	0.04	0	7.4	43.7	322
2028	16	0.05	0	3.3	19.6	341
2029	24	-0.02	0	4.9	29.4	371
2030	19	0.00	432	3.7	454.6	825
2031	14	0.05	586	2.8	602.5	1,428
2032	17	-0.04	709	3.4	730.1	2,158
2033	6	0.09	888	1.1	895.6	3,054
2034	12	0.07	872	2.4	886.0	3,940
2035	5	-0.02	898	0.9	903.5	4,843
2036	*8*	*0.05*	*886*	*0.2*	*893.9*	5,737
2037	*8*	*0.05*	*886*	*2.4*	*896.0*	6,633
2038	*8*	*0.05*	*886*	*1.6*	*895.2*	7,528
2039	*8*	*0.05*	*886*	*2.7*	*896.4*	8,425

Guidehouse CO2 converted from 000 tons to 000 metric tons

The average of 2033-2035 is used for years 2036-2039 based on similar estimated Project capacity factor.

CH4 Emissions Reduction Benefits from Displaced Units (000 mt)

	CH4 Direct	CH4 Indirect	CH4 Upstream	CH4 Year Total	CH4 Cumulative
2023	0.0012	0	0.1895	0.1907	0.1907
2024	0.0014	0	0.2342	0.2356	0.4263
2025	0.0009	0	0.1442	0.1451	0.5714
2026	0.0006	0	0.1000	0.1006	0.6721
2027	0.0007	0	0.1064	0.1070	0.7791
2028	0.0003	0	0.0471	0.0474	0.8265
2029	0.0004	0	0.0706	0.0711	0.8975
2030	0.0003	0.0	0.0533	0.0536	0.9512
2031	0.0002	0.0	0.0399	0.0402	0.9914
2032	0.0003	0.0	0.0494	0.0497	1.0410
2033	0.0001	0.0	0.0154	0.0155	1.0565
2034	0.0002	0.0	0.0340	0.0342	1.0907
2035	0.0001	0.0	0.0127	0.0128	1.1035
2036	*0.0000*	*0.0*	0.0035	*0.0035*	1.1070
2037	*0.0002*	*0.0*	0.0341	*0.0343*	1.1413
2038	*0.0001*	*0.0*	0.0232	*0.0233*	1.1646
2039	*0.0002*	*0.0*	0.0394	*0.0396*	1.2043

The average of 2033-2035 is used for years 2036-2039 based on similar estimated Project capacity factor.

N2O Emissions Reduction Benefits from Displaced Units (000 mt)

	N2O Direct	N2O Indirect	N2O Upstream	N2O Year Total	N2O Cumulative
2023	0.00012	0	0.00016	0.0003	0.0003
2024	0.00014	0	0.00020	0.0003	0.0006
2025	0.00009	0	0.00012	0.0002	0.0008
2026	0.00006	0	0.00008	0.0001	0.0010
2027	0.00006	0	0.00009	0.0002	0.0011
2028	0.00003	0	0.00004	0.0001	0.0012
2029	0.00004	0	0.00006	0.0001	0.0013
2030	0.00003	0.00	0.00004	0.0001	0.0014
2031	0.00002	0.00	0.00003	0.0001	0.0014
2032	0.00003	0.00	0.00004	0.0001	0.0015
2033	0.00001	0.00	0.00001	0.0000	0.0015
2034	0.00002	0.00	0.00003	0.0000	0.0016
2035	0.00001	0.00	0.00001	0.0000	0.0016
2036	*0.00000*	*0.00*	*0.00000*	*0.0000*	*0.0016*
2037	*0.00002*	*0.00*	*0.00003*	*0.0000*	*0.0016*
2038	*0.00001*	*0.00*	*0.00002*	*0.0000*	*0.0017*
2039	*0.00002*	*0.00*	*0.00003*	*0.0001*	*0.0017*

The average of 2033-2035 is used for years 2036-2039 based on similar estimated Project capacity factor.

Emissions Reductions Benefits Caused by the Project - Calculation of Direct CH4 and N2O

	Displaced Units MMBtu	Displaced Units mt CH4	Project mt CH4	Direct Difference mt CH4	Displaced Units mt N2O	Project mt N2O	Direct Difference mt N2O
2023	5,277,931	5.278	4.112	1.165	0.528	0.411	0.116
2024	5,209,686	5.210	3.778	1.432	0.521	0.378	0.143
2025	3,591,586	3.592	2.711	0.881	0.359	0.271	0.088
2026	2,386,406	2.386	1.776	0.611	0.239	0.178	0.061
2027	2,432,913	2.433	1.783	0.650	0.243	0.178	0.065
2028	1,155,775	1.156	0.869	0.286	0.116	0.087	0.029
2029	1,613,304	1.613	1.183	0.431	0.161	0.118	0.043
2030	1,234,309	1.234	0.910	0.324	0.123	0.091	0.032
2031	929,190	0.929	0.686	0.243	0.093	0.069	0.024
2032	1,161,339	1.161	0.860	0.302	0.116	0.086	0.030
2033	448,742	0.449	0.356	0.092	0.045	0.036	0.009
2034	872,594	0.873	0.665	0.207	0.087	0.067	0.021
2035	246,962	0.247	0.171	0.076	0.025	0.017	0.007
2036	*522,766*	*0.523*	0.504	0.019	*0.052*	0.050	0.002
2037	*522,766*	*0.523*	0.315	0.208	*0.052*	0.032	0.021
2038	*522,766*	*0.523*	0.382	0.141	*0.052*	0.038	0.014
2039	*522,766*	*0.523*	0.282	0.241	*0.052*	0.028	0.024

Displaced unit heat input based on Guidehouse analysis.
The average of 2033-2035 is used for years 2036-2039 based on similar estimated Project capacity factor.

To be conservative, displaced unit CH4 and N2O are based on same natural gas combustion emission factors as the Project, 0.00092 lb CH4/MMBtu and 0.0022 lb N2O/MMBtu, respectively.

Message

From: John, Greg [Greg.John@dep.nj.gov]
Sent: 5/14/2019 6:41:13 PM
To: Josh Ralph [jralph@ectinc.com]
CC: Zhang, Yiling [Yiling.Zhang@dep.nj.gov]
Subject: Draft Phoenix Energy Center Modeling Protocol Comments
Attachments: DRAFT_Phoenix Energy Modeling Protocol Comments.docx

Josh,

As requested, attached is a preview of the Bureau's comments on the Phoenix Energy Center Modeling Protocol. Please note that the comments in this document are considered draft; A formal comment letter is forthcoming.

Greg John
Research Scientist
609-633-1106

SUBJECT: Single Source Modeling Protocol; Phoenix Energy Center, LLC; Huntington Bay, Hunterdon County; Program Interest # 80544, Permit Activity # PCP180001

The Bureau of Evaluation and Planning (BEP) has reviewed the *Single Source Modeling Protocol for the Phoenix Energy Center Combined-Cycle Project*. The bureau provides the following comments. Please revise the modeling protocol accordingly and resubmit to the Department.

Table A-1

1. The Department is aware of the discrepancies in pollutants potential to emit between Table A-1 of the modeling protocol and Table 3-1 of the permit application. You have indicated in your email to the Department that "the PTEs in the protocol account for the reduction of the auxiliary boiler hours from 8,760 hours per year to 4,000 hours per year and increasing the sulfur content of the natural gas from 0.4 gr/100 scf to 0.6 gr/100 scf." You also indicated that you are currently working on revising the application to incorporate these changes. Please ensure that these discrepancies are properly addressed.

2. Please revise Table A-1 to address potential hydrogen sulfide (H_2S) and fluoride emissions as compared to the Prevention of Significant Deterioration emissions increase thresholds.

Section 1.4 Applicable Pollutants (See also Section 5.8)

3. While the SO_2 potential to emit for this project is 37.52 tons/yr is less that the 40 tons/yr significant emissions increase threshold, it is the Department's position that 37.52 tons/yr of SO_2 emissions is close enough to the 40 tons/yr major source threshold that SO_2 should be included in the air dispersion modeling for air quality compliance demonstration. Please update stack parameters and emissions rate tables in Appendix A to include the corresponding SO_2 modeling parameters.

Section 2.3.1 Project Sources and Operating Scenarios

4. It is stated in this section that the auxiliary boiler and the combustion turbine will have some overlapping operation during startup and shutdown. Please specify how this overlapping will be modeled (in reference to Section 2.6.2) and list the model input parameters for this overlapping scenario modeling.

Section 2.3.4.1 CT Short-Term Stack Parameters & Table A-3

5. Table A-3 lists the combustion turbine's maximum emission rates calculated for various scenarios, including load and ambient conditions. In addition to emission rates listed in this table, please include SO_2 emissions and the exit volume and temperature for different loads and environmental conditions.

Section 2.3.4.2 Startup and Shutdown Stack Parameters & Table A-5

6. Table A-5 lists separately stack parameters of the startup event and the balance of the maximum base load event. Please include discussion of how the two operating conditions will be modeled to calculate 1-hour CO, NO_2 and SO_2 impact concentrations, as well as, the 8-hour CO and 24-hour PM_{10}/$PM_{2.5}$ impact concentrations.

7. In Table A-5, why are the 8-hour average emission rates for CO greater than the 1-hour average emission rates?

Section 2.3.4.3 CT Annual, 24-Hour, and 8-Hour Average Stack Parameters

8. Table A-6 only lists modeled pollutants' potential annual emissions. Please also provide the stack parameters to be used for annual average modeling. In addition, please clarify what the short-term average emission rates and stack parameters will be modeled (Table A-3?). Please note when modeling any source, worst-case parameters must be evaluated. For example, when modeling short-term emission rates, please use minimum temperatures/flow rates, and when modeling long-term emission rates, please use average temperatures/flow rates.

Section 2.3.4.4 Stack Parameters for Auxiliary Boiler

9. Please specify how the overlapping impact of the auxiliary boiler and the combustion turbine will be modeled.

Section 2.3.4.5 Stack Parameters for Dewpoint Heater

10. The permit application lists only one dewpoint heater, while Table A-8 lists emission rates and stack parameters of two dewpoint heaters.

Section 2.3.4.6 Stack Parameters for Two Space Heaters

11. The permit application lists parameters for two space heaters, while Table A-9 only lists one space heater.

12. According to the application, the two space heaters are each at 20 ft tall, 6 inches in diameter, minimum exhaust temperature of 400 °F, and no listed flow rates. However, in Table A-9, the one space heater is listed at 71 ft tall, 10 ft in diameter, stack temperature of 70 °F, and exhaust flow rate of 100,000 acfm.

Section 2.3.5 Good Engineering Practice Stack Height and Building Downwash Evaluation

13. Please provide tables identifying all buildings with the potential to cause aerodynamic downwash of emissions for each of the stacks (emission points) modeled. For each stack, a table should provide the following data for each building:

a. Building height (relative to stack base elevation);
b. Maximum projected building width;
c. Distance from the stack;
d. 5L distance; and
e. Calculated formula GEP stack height.

14. A survey or plot plan of the proposed facility should be submitted as part of the air dispersion modeling protocol.

Section 2.5 Meteorological Data

15. The comparison of Lehigh Valley Airport and Sussex County Airport surface characteristics (i.e., surface roughness values and terrain) with characteristics at the proposed site does not definitively indicate that one meteorological data set is more representative of the project site than the other. Are there any other locations close to the project site with meteorological observations that can be used for further comparison?

Section 2.6.1 Justification of Use of SILs & Table 2-2

16. Table 2-2 lists "Representative Background/Design Concentration". Please clarify which monitoring station and time period the background concentrations represent.

17. Table 2-2 listed the NESCAUM NO_2 SIL of 10 ug/m^3. If this value is predicted to be exceeded during the single source modeling, then the EPA NO_2 SIL of 7.5 ug/m^3 shall be used in the multisource modeling.

Section 2.6.4 NAAQS and PSD Increments Analysis

18. If the project source impact of a pollutant is less than its applicable SIL, the corresponding background concentration needs to be added to the modeled impact to demonstrate compliance with the applicable New Jersey and National Ambient Air Quality Standards (NAAQS).

Section 2.6.5.2 Secondary $PM_{2.5}$

19. Estimation of the secondary impacts should be consistent with the EPA "*Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool for Ozone and $PM_{2.5}$ under the PSD Permitting Program*" signed on April 30, 2019.

Section 3.0 Representative Background Ambient Concentrations

20. The Bureau agrees that the most recent three-years of available monitoring data from the Freemansburg, PA site can be used for NO_2 and $PM_{2.5}$ modeling; data from the Allentown site for PM_{10} modeling; and data from the Torresdale site for CO modeling. Please include a SO_2 background monitoring location.

21. Please provide a table listing the representative monitor values for all three years or, when applicable, the 3-year average values.

Section 5.5 Health Risk Assessment

22. Health risk assessment needs to be conducted on any toxic air pollutant with potential to emit exceeding the reporting threshold listed in N.J.A.C. 7:27 Subchapter 22. Please provide a table listing such toxic air pollutants with their potential to emit for the Phoenix Energy Center. Please also describe methodologies to be used to conduct risk assessment. The Department's Guidance on Preparing a Risk assessment for Air Contaminant Emissions (Technical Manual 1003) can be found at: [HYPERLINK "https://www.state.nj.us/dep/aqpp/techman.html"] .

Message

From: John, Greg [Greg.John@dep.nj.gov]
Sent: 5/14/2019 6:44:32 PM
To: Colecchia, Annamaria [Colecchia.Annamaria@epa.gov]; Sareen, Neha [sareen.neha@epa.gov]
CC: Zhang, Yiling [Yiling.Zhang@dep.nj.gov]
Subject: DRAFT Phoenix Energy Center Protocol Comments
Attachments: PHOENIX_PROTOCOL_COMMENTS_5_14_19.doc

Annamaria/Neha,

Attached is our letter version of the Phoenix Energy Center comments. Please lets us know if you have any changes or additions. We especially would like your opinion of the requested met data set for use in the compliance demonstration.

Greg John
Research Scientist
609-633-1106

[EMBED Word.Picture.8]

DEPARTMENT OF ENVIRONMENTAL PROTECTION
AIR QUALITY, ENERGY AND SUSTAINABILITY
DIVISION OF AIR QUALITY
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TRENTON, NJ 08625-0420
609 - 984 - 1484

PHILIP D. MURPHY
Governor

SHEILA OLIVER
Lt. Governor

CATHERINE R. McCABE
Commissioner

May ???, 2019

Mr. Joshua Ralph
ECT, Inc.
7208 Falls of Neuse Road, Suite 102
Raleigh, NC 27615

SUBJECT: Single Source Modeling Protocol; Phoenix Energy Center, LLC; Huntington Bay, Hunterdon County; Program Interest # 80544, Permit Activity # PCP180001

The Bureau of Evaluation and Planning (BEP) has reviewed the *Single Source Modeling Protocol for the Phoenix Energy Center Combined-Cycle Project*. The bureau provides the following comments. Please revise the modeling protocol accordingly and resubmit to the Department.

<u>Table A-1</u>

1. The Department is aware of the discrepancies in pollutants potential to emit between Table A-1 of the modeling protocol and Table 3-1 of the permit application. You have indicated in your email to the Department that "the PTEs in the protocol account for the reduction of the auxiliary boiler hours from 8,760 hours per year to 4,000 hours per year and increasing the sulfur content of the natural gas from 0.4 gr/100 scf to 0.6 gr/100 scf." You also indicated that you are currently working on revising the application to incorporate these changes. Please ensure that these discrepancies are properly addressed.

2. Please revise Table A-1 to address potential hydrogen sulfide (H_2S) and fluoride emissions as compared to the Prevention of Significant Deterioration emissions increase thresholds.

<u>Section 1.4 Applicable Pollutants (See also Section 5.8)</u>

3. While the SO_2 potential to emit for this project is 37.52 tons/yr is less that the 40 tons/yr significant emissions increase threshold, it is the Department's position that 37.52 tons/yr of SO_2 emissions is close enough to the 40 tons/yr major source threshold that SO_2 should be included in the air dispersion modeling for air quality compliance demonstration. Please update stack

parameters and emissions rate tables in Appendix A to include the corresponding SO_2 modeling parameters.

Section 2.3.1 Project Sources and Operating Scenarios

4. It is stated in this section that the auxiliary boiler and the combustion turbine will have some overlapping operation during startup and shutdown. Please specify how this overlapping will be modeled (in reference to Section 2.6.2) and list the model input parameters for this overlapping scenario modeling.

Section 2.3.4.1 CT Short-Term Stack Parameters & Table A-3

5. Table A-3 lists the combustion turbine's maximum emission rates calculated for various scenarios, including load and ambient conditions. In addition to emission rates listed in this table, please include SO_2 emissions and the exit volume and temperature for different loads and environmental conditions.

Section 2.3.4.2 Startup and Shutdown Stack Parameters & Table A-5

6. Table A-5 lists separately stack parameters of the startup event and the balance of the maximum base load event. Please include discussion of how the two operating conditions will be modeled to calculate 1-hour CO, NO_2 and SO_2 impact concentrations, as well as, the 8-hour CO and 24-hour $PM_{10}/PM_{2.5}$ impact concentrations.

7. In Table A-5, why are the 8-hour average emission rates for CO greater than the 1-hour average emission rates?

Section 2.3.4.3 CT Annual, 24-Hour, and 8-Hour Average Stack Parameters

8. Table A-6 only lists modeled pollutants' potential annual emissions. Please also provide the stack parameters to be used for annual average modeling. In addition, please clarify what the short-term average emission rates and stack parameters will be modeled (Table A-3?). Please note when modeling any source, worst-case parameters must be evaluated. For example, when modeling short-term emission rates, please use minimum temperatures/flow rates, and when modeling long-term emission rates, please use average temperatures/flow rates.

Section 2.3.4.4 Stack Parameters for Auxiliary Boiler

9. Please specify how the overlapping impact of the auxiliary boiler and the combustion turbine will be modeled.

Section 2.3.4.5 Stack Parameters for Dewpoint Heater

10. The permit application lists only one dewpoint heater, while Table A-8 lists emission rates and stack parameters of two dewpoint heaters.

Section 2.3.4.6 Stack Parameters for Two Space Heaters

11. The permit application lists parameters for two space heaters, while Table A-9 only lists one space heater.

12. According to the application, the two space heaters are each at 20 ft tall, 6 inches in diameter, minimum exhaust temperature of 400 °F, and no listed flow rates. However, in Table A-9, the one space heater is listed at 71 ft tall, 10 ft in diameter, stack temperature of 70 °F, and exhaust flow rate of 100,000 acfm.

Section 2.3.5 Good Engineering Practice Stack Height and Building Downwash Evaluation

13. Please provide tables identifying all buildings with the potential to cause aerodynamic downwash of emissions for each of the stacks (emission points) modeled. For each stack, a table should provide the following data for each building:

a. Building height (relative to stack base elevation);
b. Maximum projected building width;
c. Distance from the stack;
d. 5L distance; and
e. Calculated formula GEP stack height.

14. A survey or plot plan of the proposed facility should be submitted as part of the air dispersion modeling protocol.

Section 2.5 Meteorological Data

15. The comparison of Lehigh Valley Airport and Sussex County Airport surface characteristics (i.e., surface roughness values and terrain) with characteristics at the proposed site does not definitively indicate that one meteorological data set is more representative of the project site than the other. Are there any other locations close to the project site with meteorological observations that can be used for further comparison?

Section 2.6.1 Justification of Use of SILs & Table 2-2

16. Table 2-2 lists "Representative Background/Design Concentration". Please clarify which monitoring station and time period the background concentrations represent.

17. Table 2-2 listed the NESCAUM NO_2 SIL of 10 ug/m^3. If this value is predicted to be exceeded during the single source modeling, then the EPA NO_2 SIL of 7.5 ug/m^3 shall be used in the multisource modeling.

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Please contact me by e-mail, [HYPERLINK "mailto:Yiling.Zhang@dep.nj.gov"] , or telephone, at 609-292-0393, if you have any questions regarding the protocol comments.

Sincerely,

Yiling Zhang

CC: D. Owen, BSS; A. Khan, BSS; G. John, BEP; A. Colecchia, EPA; N. Sareen, EPA